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APPLICATION NUMBER: ***60/531,300***
FILING DATE: ***December 19, 2003***
RELATED PCT APPLICATION NUMBER: ***PCT/US04/42302***

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PROVISIONAL APPLICATION FOR PATENT COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

Express Mail Label No. EV 334739672 US

INVENTOR(S)

Given Name (first and middle [if any])	Family Name or Surname	Residence (City and either State or Foreign Country)
DAVID ALAN	CLARK	LANDENBERG, PENNSYLVANIA
BRUCE LAWRENCE	FINKELSTEIN	NEWARK, DELAWARE

Additional inventors are being named on the ______ *separately numbered sheets attached hereto*

TITLE OF THE INVENTION (500 characters max)

HERBICIDAL PYRIMIDINES

Direct all correspondence to: **CORRESPONDENCE ADDRESS**

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ENCLOSED APPLICATION PARTS *(check all that apply)*

☑ Specification *Number of Pages* 61

☐ Drawing(s) *Number of Sheets* ______

☐ Application Date Sheet. See 37 CFR 1.76

☐ CD(s), Number ______

☐ Other (specify) ______

METHOD OF PAYMENT OF FILING FEES FOR THIS PROVISIONAL APPLICATION FOR PATENT

☐ Applicant claims small entity status. See 37 CFR 1.27.

☐ A check or money order is enclosed to cover the filing fees.

☑ The Director is herby authorized to charge filing fees or credit any overpayment to Deposit Account Number: **04-1928**

☐ Payment by credit card. Form PTO-2038 is attached.

FILING FEE Amount ($): $160.00

The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.

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Respectfully submitted,

SIGNATURE Linda D. Birch

TYPED or PRINTED NAME LINDA D. BIRCH

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Date DECEMBER 19, 2003

REGISTRATION NO. 38,719
(if appropriate)
Docket Number: BA9323USPRV

USE ONLY FOR FILING A PROVISIONAL APPLICATION FOR PATENT

121903 17264 U.S. PTO

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FEE TRANSMITTAL for FY 2004

Effective 10/01/2003. Patent fees are subject to annual revision.

☐ Applicant claims small entity status. See 37 CFR 1.27

TOTAL AMOUNT OF PAYMENT ($) 160.00

Complet if Known	
Application Number	UNKNOWN
Filing Date	HEREWITH
First Named Inventor	DAVID A. CLARK
Examiner Name	UNKNOWN
Art Unit	UNKNOWN
Attorney Docket No.	BA9323 US PRV

METHOD OF PAYMENT *(check all that apply)*

☐ Check ☐ Credit card ☐ Money Order ☐ Other ☐ None

☑ Deposit Account:

Deposit Account Number: **04-1928**

Deposit Account Name: **E. I. du Pont de Nemours and Company**

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FEE CALCULATION

1. BASIC FILING FEE

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
1001	770	2001	385	Utility filing fee	
1002	340	2002	170	Design filing fee	
1003	530	2003	265	Plant filing fee	
1004	770	2004	385	Reissue filing fee	
1005	160	2005	80	Provisional filing fee	160.00

SUBTOTAL (1) ($) 160.00

2. EXTRA CLAIM FEES FOR UTILITY AND REISSUE

			Extra Claims		Fee from below		Fee Paid
Total Claims		-20** =		X	18	=	
Independent Claims		- 3** =		X	86	=	
Multiple Dependent	☐ YES				290.00	=	

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description
1202	18	2202	9	Claims in excess of 20
1201	86	2201	43	Independent claims in excess of 3
1203	290	2203	145	Multiple dependent claim, if not paid
1204	86	2204	43	** Reissue independent claims over original patent
1205	18	2205	9	** Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) ($) 0.00

**or number previously paid, if greater; For Reissues, see above*

FEE CALCULATION (continued)

3. ADDITIONAL FEES

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
1051	130	2051	65	Surcharge - late filing fee or oath	
1052	50	2052	25	Surcharge - late provisional filing fee or cover sheet	
1053	130	1053	130	Non-English specification	
1812	2,520	1812	2,520	For filing a request for *ex parte* reexamination	
1804	920*	1804	920*	Requesting publication of SIR prior to Examiner action	
1805	1,840*	1805	1,840*	Requesting publication of SIR after Examiner action	
1251	110	2251	55	Extension for reply within first month	
1252	420	2252	210	Extension for reply within second month	
1253	950	2253	475	Extension for reply within third month	
1254	1,480	2254	740	Extension for reply within fourth month	
1255	2,010	2255	1,005	Extension for reply within fifth month	
1401	330	2401	165	Notice of Appeal	
1402	330	2402	165	Filing a brief in support of an appeal	
1403	290	2403	145	Request for oral hearing	
1451	1,510	1451	1,510	Petition to institute a public use proceeding	
1452	110	2452	55	Petition to revive - unavoidable	
1453	1,330	2453	665	Petition to revive - unintentional	
1501	1,330	2501	665	Utility issue fee (or reissue)	
1502	480	2502	240	Design issue fee	
1503	640	2503	320	Plant issue fee	
1460	130	1460	130	Petitions to the Commissioner	
1807	50	1807	50	Processing fee under 37 CFR 1.17(q)	
1806	180	1806	180	Submission of Information Disclosure Stmt	
8021	40	8021	40	Recording each patent assignment per property (times number of properties)	
1809	770	2809	385	Filing a submission after final rejection (37 CFR 1.129(a))	
1810	770	2810	385	For each additional invention to be examined (37 CFR 1.129(b))	
1801	770	2801	385	Request for Continued Examination (RCE)	
1802	900	1802	900	Request for expedited examination of a design application	

Other fee (specify) ____________

*Reduced by Basic Filing Fee Paid

SUBTOTAL (3) ($) 0.00

SUBMITTED BY

(Complete *(if applicable)*)

Name (Print/Type)	Linda D. Birch	*Registration No. (Attorney/Agent)*	38,719	*Telephone*	(302) 992-4949
Signature	Linda D. Birch			*Date*	DECEMBER 19, 2003

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TITLE
HERBICIDAL PYRIMIDINES

FIELD OF THE INVENTION

This invention relates to certain pyrimidines, their *N*-oxides, agriculturally suitable salts and compositions, and methods of their use for controlling undesirable vegetation.

BACKGROUND OF THE INVENTION

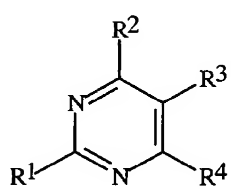
The control of undesired vegetation is extremely important in achieving high crop efficiency. Achievement of selective control of the growth of weeds especially in such useful crops as rice, soybean, sugar beet, corn (maize), potato, wheat, barley, tomato and plantation crops, among others, is very desirable. Unchecked weed growth in such useful crops can cause significant reduction in productivity and thereby result in increased costs to the consumer. The control of undesired vegetation in noncrop areas is also important. Many products are commercially available for these purposes, but the need continues for new compounds which are more effective, less costly, less toxic, environmentally safer or have different modes of action.

European Patent Publication EP-519211-A1 discloses pyrimidines useful for controlling insects, mites and certain other animal invertebrates. This reference does not disclose the compounds of the present invention or their herbicidal utility.

SUMMARY OF THE INVENTION

This invention is directed to a compound of Formula **I**, including all geometric and stereoisomers, *N*-oxides or agriculturally suitable salts thereof, agricultural compositions containing them and their use as herbicides:

This invention is directed to a compound of Formula **I** including all geometric and stereoisomers, *N*-oxides or agriculturally suitable salts thereof, agricultural compositions containing them and their use as herbicides:



I

wherein

R^1 is cyclopropyl optionally substituted with 1–5 R^5, isopropyl optionally substituted with 1–5 R^6, or phenyl optionally substituted with 1–2 R^7; or R^1 is halogen, OR^8, SR^9 or $N(R^{10})R^{11}$;

R^2 is CO_2R^{12}, CH_2OR^{13}, CHO, $C(=NOR^{14})H$, $C(R^{15})(R^{16})CO_2R^{17}$ or $C(=O)N(R^{18})R^{19}$;

R^3 is halogen, cyano, nitro, OR^{20}, SR^{21} or $N(R^{22})R^{23}$;

R^4 is $-N(R^{24})R^{25}$ or $-NO_2$;

each R^5 and R^6 is independently halogen, C_1–C_2 alkyl or C_1–C_2 haloalkyl;

each R^7 is independently halogen, C_1–C_4 alkyl, C_1–C_3 haloalkyl, C_1–C_3 alkoxy, C_1–C_3 haloalkoxy, C_1–C_3 alkylthio or C_1–C_3 haloalkylthio;

R^8 is H, C_1–C_4 alkyl, C_1–C_3 haloalkyl or phenyl optionally substituted with 1–2 R^{26};

R^9 is H, C_1–C_4 alkyl or C_1–C_3 haloalkyl;

R^{10} is H or C_1–C_4 alkyl;

R^{11} is C_1–C_4 alkyl;

or R^{10} and R^{11} are taken together as $-(CH_2)_m-$ or $-(CH_2)_2O(CH_2)_2-$;

R^{12} is H; or a radical selected from C_1–C_{14} alkyl, C_3–C_{12} cycloalkyl, C_4–C_{12} alkylcycloalkyl, C_4–C_{12} cycloalkylalkyl, C_2–C_{14} alkenyl and C_2–C_{14} alkynyl, each radical optionally substituted with 1–3 R^{27};

R^{13} is H, C_1–C_{10} alkyl optionally substituted with 1–3 R^{28} or benzyl;

R^{14} is H, C_1–C_4 alkyl or C_1–C_4 haloalkyl;

R^{15} and R^{16} are independently H, halogen, C_1–C_4 alkyl, C_1–C_4 haloalkyl, hydroxy or C_1–C_4 alkoxy;

R^{17} is C_1–C_{10} alkyl optionally substituted with 1–3 R^{29} or benzyl;

R^{18} and R^{19} are independently H or C_1–C_4 alkyl;

R^{20} is H, C_1–C_4 alkyl or C_1–C_3 haloalkyl;

R^{21} is H, C_1–C_4 alkyl or C_1–C_3 haloalkyl;

R^{22} and R^{23} are independently H or C_1–C_4 alkyl;

R^{24} is H, C_1–C_4 alkyl optionally substituted with 1–2 R^{30}, C_2–C_4 alkenyl optionally substituted with 1–2 R^{31}, or C_2–C_4 alkynyl optionally substituted with 1–2 R^{32}; or R^{24} is $C(=O)R^{33}$, nitro, OR^{34}, $S(O)_2R^{35}$ or $N(R^{36})R^{37}$;

R^{25} is H, C_1–C_4 alkyl optionally substituted with 1–2 R^{30} or $C(=O)R^{33}$; or

R^{24} and R^{25} are taken together as a radical selected from $-(CH_2)_4-$, $-(CH_2)_5-$, $-CH_2CH{=}CHCH_2-$ and $-(CH_2)_2O(CH_2)_2-$, each radical optionally substituted with 1–2 R^{38}; or

R^{24} and R^{25} are taken together as $=C(R^{39})N(R^{40})R^{41}$ or $=C(R^{42})OR^{43}$;

each R^{26} is independently halogen, C_1–C_4 alkyl, C_1–C_3 haloalkyl, C_1–C_3 alkoxy, C_1–C_3 haloalkoxy, C_1–C_3 alkylthio or C_1–C_3 haloalkylthio;

each R^{27} is independently halogen, hydroxycarbonyl, C_2–C_4 alkoxycarbonyl, hydroxy, C_1–C_4 alkoxy, C_1–C_4 haloalkoxy, C_1–C_4 alkylthio, C_1–C_4 haloalkylthio, amino, C_1–C_4 alkylamino, C_1–C_4 dialkylamino, $-CH[O(CH_2)_n]$ or phenyl optionally substituted with 1–3 R^{44}; or

two R^{27} are taken together with the carbon atom to which they are attached to form a carbonyl moiety;

each R^{28} and R^{29} is independently halogen, C_1–C_4 alkoxy, C_1–C_4 haloalkoxy, C_1–C_4 alkylthio, C_1–C_4 haloalkylthio, amino, C_1–C_4 alkylamino or C_1–C_4 dialkylamino;

each R^{30}, R^{31} and R^{32} is independently halogen, hydroxy, C_1–C_4 alkoxy, C_1–C_4 haloalkoxy, C_1–C_4 alkylthio, C_1–C_4 haloalkylthio, amino, C_1–C_4 alkylamino, C_1–C_4 dialkylamino or C_2–C_4 alkoxycarbonyl;

each R^{33} is independently H, C_1–C_4 alkyl, C_1–C_3 haloalkyl, C_1–C_4 alkoxy, phenoxy or benzyloxy;

R^{34} is H, C_1–C_4 alkyl or C_1–C_3 haloalkyl;

R^{35} is C_1–C_4 alkyl or C_1–C_3 haloalkyl;

R^{36} and R^{37} are independently H or C_1–C_4 alkyl;

each R^{38} is independently halogen, C_1–C_3 alkyl, C_1–C_3 alkoxy, C_1–C_3 haloalkoxy, C_1–C_3 alkylthio, C_1–C_3 haloalkylthio, amino, C_1–C_3 alkylamino, C_1–C_4 dialkylamino or C_2–C_4 alkoxycarbonyl;

R^{39} is H or C_1–C_4 alkyl;

R^{40} and R^{41} are independently H or C_1–C_4 alkyl; or

R^{40} and R^{41} are taken together as $-(CH_2)_4-$, $-(CH_2)_5-$, $-CH_2CH{=}CHCH_2-$ or $-(CH_2)_2O(CH_2)_2-$;

R^{42} is H or C_1–C_4 alkyl;

R^{43} is H or C_1–C_4 alkyl;

each R^{44} is independently halogen, C_1–C_4 alkyl, C_1–C_3 haloalkyl, hydroxy, C_1–C_4 alkoxy, C_1–C_3 haloalkoxy, C_1–C_4 alkylthio, C_1–C_3 haloalkylthio, amino, C_1–C_3 alkylamino, C_1–C_4 dialkylamino or nitro;

m is an integer from 2 to 5; and

n is an integer from 1 to 4;

provided that:

(a) when R^2 is CH_2OR^{13}, then R^1 is other than SCH_3, and R^{24} and R^{25} are H;

(b) when R^1 and R^3 are halogen, then R^4 is NH_2; and

(c) when R^1 is SCH_3, then R^3 is Cl.

More particularly, this invention pertains to a compound of Formula **I**, including all geometric and stereoisomers, *N*-oxides or agriculturally suitable salts thereof. This invention also relates to a herbicidal composition comprising a herbicidally effective amount of a compound of Formula **I** and at least one of a surfactant, a solid diluent or a liquid diluent. This invention further relates to a method for controlling the growth of undesired vegetation comprising contacting the vegetation or its environment with a herbicidally effective amount of a compound of Formula **I** (e.g., as a composition described herein). This invention also

relates to a herbicidal composition comprising a herbicidally effective amount of a compound of Formula **I**, an effective amount of at least one additional active ingredient selected from the group consisting of an other herbicide and a herbicide safener, and at least one of a surfactant, a solid diluent or a liquid diluent.

DETAILS OF THE INVENTION

In the above recitations, the term "alkyl", used either alone or in compound words such as "alkylthio" or "haloalkyl" includes straight-chain or branched alkyl, such as, methyl, ethyl, *n*-propyl, *i*-propyl, or the different butyl, pentyl or hexyl isomers. "Alkenyl" includes straight-chain or branched alkenes such as ethenyl, 1-propenyl, 2-propenyl, and the different butenyl, pentenyl and hexenyl isomers. "Alkenyl" also includes polyenes such as 1,2-propadienyl and 2,4-hexadienyl. "Alkoxy" includes, for example, methoxy, ethoxy, *n*-propyloxy, isopropyloxy and the different butoxy, pentoxy and hexyloxy isomers. "Alkoxyalkyl" denotes alkoxy substitution on alkyl. "Alkylthio" includes branched or straight-chain alkylthio moieties such as methylthio, ethylthio, and the different propylthio, butylthio, pentylthio and hexylthio isomers. "Alkylamino", "dialkylamino", and the like, are defined analogously to the above examples. "Cycloalkyl" includes, for example, cyclopropyl, cyclobutyl, cyclopentyl, and cyclohexyl. Examples of "cycloalkylalkyl" include cyclopropylmethyl, cyclopentylethyl, and other cycloalkyl moieties bonded to straight-chain or branched alkyl groups. "Alkylcycloalkyl" denotes alkyl substitution on a cycloalkyl moiety. Examples include 4-methylcyclohexyl and 3-ethylcyclopentyl. One skilled in the art will recognize that pyrimidine heterocycles and tertiary amines can form *N*-oxides. Synthetic methods for the preparation of *N*-oxides of heterocycles and tertiary amines are very well known by one skilled in the art including the oxidation of heterocycles and tertiary amines with peroxy acids such as peracetic and *m*-chloroperbenzoic acid (MCPBA), hydrogen peroxide, alkyl hydroperoxides such as *t*-butyl hydroperoxide, sodium perborate, and dioxiranes such as dimethydioxirane. These methods for the preparation of *N*-oxides have been extensively described and reviewed in the literature, see for example: T. L. Gilchrist in *Comprehensive Organic Synthesis*, vol. 7, pp 748–750, S. V. Ley, Ed., Pergamon Press; M. Tisler and B. Stanovnik in *Comprehensive Heterocyclic Chemistry*, vol. 3, pp 18–20, A. J. Boulton and A. McKillop, Eds., Pergamon Press; M. R. Grimmett and B. R. T. Keene in *Advances in Heterocyclic Chemistry*, vol. 43, pp 149–161, A. R. Katritzky, Ed., Academic Press; M. Tisler and B. Stanovnik in *Advances in Heterocyclic Chemistry*, vol. 9, pp 285–291, A. R. Katritzky and A. J. Boulton, Eds., Academic Press; and G. W. H. Cheeseman and E. S. G. Werstiuk in *Advances in Heterocyclic Chemistry*, vol. 22, pp 390–392, A. R. Katritzky and A. J. Boulton, Eds., Academic Press.

The term "halogen", either alone or in compound words such as "haloalkyl", includes fluorine, chlorine, bromine or iodine. The term "1–2 halogen" indicates that one or two of the available positions for that substituent may be halogen which are independently selected.

Further, when used in compound words such as "haloalkyl", said alkyl may be partially or fully substituted with halogen atoms which may be the same or different. Examples of "haloalkyl" include F_3C, $ClCH_2$, CF_3CH_2 and CF_3CCl_2. Examples of "haloalkoxy" include CF_3O, CCl_3CH_2O, $HCF_2CH_2CH_2O$ and CF_3CH_2O. Examples of "haloalkylthio" include CCl_3S, CF_3S, CCl_3CH_2S and $ClCH_2CH_2CH_2S$.

The total number of carbon atoms in a substituent group is indicated by the "C_i–C_j" prefix where i and j are numbers from 1 to 14. For example, C_1–C_3 alkylthio designates methylthio through propylthio. Examples of C_2–C_4 alkoxycarbonyl include $CH_3OC(=O)$, $CH_3CH_2OC(=O)$, $CH_3CH_2CH_2OC(=O)$ and $(CH_3)_2CHOC(=O)$.

Compounds of this invention can exist as one or more stereoisomers. The various stereoisomers include enantiomers, diastereomers, atropisomers and geometric isomers. One skilled in the art will appreciate that one stereoisomer may be more active and/or may exhibit beneficial effects when enriched relative to the other stereoisomer(s) or when separated from the other stereoisomer(s). Additionally, the skilled artisan knows how to separate, enrich, and/or to selectively prepare said stereoisomers. Accordingly, the present invention comprises compounds selected from Formula **I**, *N*-oxides and agriculturally suitable salts thereof. The compounds of the invention may be present as a mixture of stereoisomers, individual stereoisomers, or as an optically active form.

The agriculturally suitable salts of the compounds of the invention include acid-addition salts with inorganic or organic acids such as hydrobromic, hydrochloric, nitric, phosphoric, sulfuric, acetic, butyric, fumaric, lactic, maleic, malonic, oxalic, propionic, salicylic, tartaric, 4-toluenesulfonic or valeric acids. The agriculturally suitable salts of the compounds of the invention also include those formed with strong bases (e.g., hydrides or hydroxides of sodium, potassium or lithium). One skilled in the art recognizes that because in the environment and under physiological conditions salts of the compounds of the invention are in equilibrium with their corresponding nonsalt forms, agriculturally suitable salts share the biological utility of the nonsalt forms.

Preferred for reason of cost, ease of synthesis and/or biological efficacy is:

Preferred 1. A compound of Formula **I** wherein R^1 is cyclopropyl.

Preferred 2. A compound of Formula **I** wherein R^2 is CO_2R^{12}, CH_2OR^{13}, CHO or $CH_2CO_2R^{17}$.

Preferred 3. A compound of Preferred 2 wherein R^2 is CO_2R^{12}.

Preferred 4. A compound of Preferred 3 wherein R^{12} is H or C_1–C_4 alkyl.

Preferred 5. A compound of Preferred 4 wherein R^{12} is C_1–C_2 alkyl.

Preferred 6. A compound of Formula **I** wherein R^3 is halogen.

Preferred 7. A compound of Preferred 6 wherein R^3 is Br or Cl.

Preferred 8. A compound of Preferred 7 wherein R^3 is Cl.

Preferred 9. A compound of Formula **I** wherein R^4 is $-N(R^{24})R^{25}$.

Preferred 10. A compound of Preferred 9 wherein R^{24} is H or C_1–C_4 alkyl optionally substituted with R^{30}; R^{25} is H or C_1–C_2 alkyl; or R^{24} and R^{25} are taken together as $=C(R^{39})N(R^{40})R^{41}$.

Preferred 11. A compound of Preferred 10 wherein R^{24} is H or C_1–C_4 alkyl optionally substituted with R^{30}; and R^{25} is H or C_1–C_2 alkyl.

Preferred 12. A compound of Preferred 11 wherein R^{24} and R^{25} are independently H or methyl.

Preferred 13. A compound of Preferred 12 wherein R^{24} and R^{25} are H.

Preferred 14. A compound of Formula **I** wherein R^{30} is halogen, methoxy, C_1 fluoroalkoxy, methylthio, C_1 fluoroalkylthio, amino, methylamino, dimethylamino or methoxycarbonyl.

Preferred 15. A compound of Formula **I** wherein R^{39} is H or C_1–C_2 alkyl.

Preferred 16. A compound of Formula **I** wherein R^{40} and R^{41} are independently H or C_1–C_2 alkyl.

Combinations of preferred groups are illustrated by:

Preferred A. A compound of Formula **I** wherein R^1 is cyclopropyl; and R^4 is $-N(R^{24})R^{25}$.

Preferred B. A compound of Preferred A wherein R^2 is CO_2R^{12}; and R^{24} and R^{25} are H.

Preferred C. A compound of Preferred A wherein R^3 is halogen.

Preferred D. A compound of Preferred C wherein R^2 is CO_2R^{12}, CH_2OR^{13}, CHO or $CH_2CO_2R^{17}$.

Preferred E. A compound of Preferred D wherein R^{24} is H or C_1–C_4 alkyl optionally substituted with R^{30}; R^{25} is H or C_1–C_2 alkyl; or R^{24} and R^{25} are taken together as $=C(R^{39})N(R^{40})R^{41}$.

Preferred F. A compound of Preferred E wherein R^2 is CO_2R^{12}; and R^{12} is H or C_1–C_4 alkyl.

Preferred G. A compound of Preferred F wherein R^{24} and R^{25} are H.

Specifically preferred is a compound of Formula **I** selected from the group consisting of:

methyl 6-amino-5-bromo-2-cyclopropyl-4-pyrimidinecarboxylate,

ethyl 6-amino-5-bromo-2-cyclopropyl-4-pyrimidinecarboxylate,

methyl 6-amino-5-chloro-2-cyclopropyl-4-pyrimidinecarboxylate, and

ethyl 6-amino-5-chloro-2-cyclopropyl-4-pyrimidinecarboxylate.

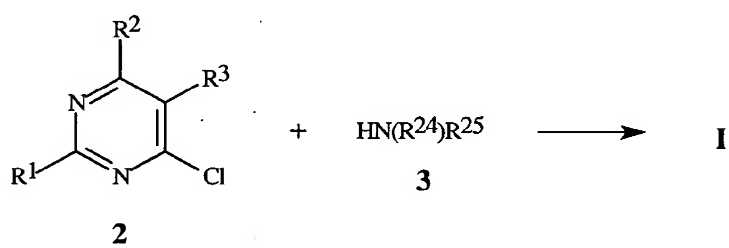
The preferred herbicidal compositions of the present invention are those involving the above preferred compounds.

This invention also relates to a method for controlling undesired vegetation comprising applying to the locus of the vegetation herbicidally effective amounts of the compounds of the invention (e.g., as a composition described herein). The preferred methods of use are those involving the above preferred compounds.

The compounds of Formula **I** can be prepared by one or more of the following methods and variations as described in Schemes 1 through 7 and accompanying text. The definitions of R^1, R^2, R^3, R^4, R^5, R^6, R^7, R^8, R^9, R^{10}, R^{11}, R^{12}, R^{13}, R^{14}, R^{15}, R^{16}, R^{17}, R^{18}, R^{19}, R^{20}, R^{21}, R^{22}, R^{23}, R^{24}, R^{25}, R^{26}, R^{27}, R^{28}, R^{29}, R^{30}, R^{31}, R^{32}, R^{33}, R^{34}, R^{35}, R^{36}, R^{37}, R^{38}, R^{39}, R^{40}, R^{41}, R^{42}, R^{43}, R^{44}, m and n in the compounds of Formulae **I** through **12** below are as defined above in the Summary of the Invention and description of preferred embodiments unless otherwise indicated.

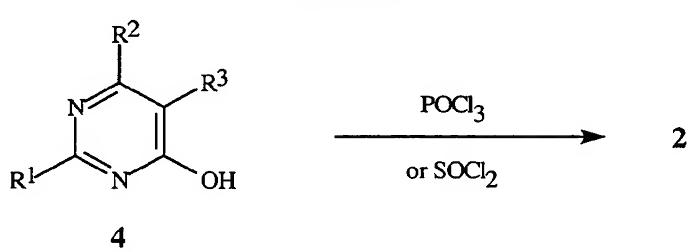
Compounds of Formula **I** can be prepared from chlorides of Formula **2** by reaction with amines of Formula **3**, optionally in the presence of a base such as triethylamine or potassium carbonate as outlined in Scheme 1. The reaction can be run in a variety of solvents including tetrahydrofuran, *p*-dioxane, ethanol and methanol with optimum temperatures ranging from room temperature to 200 °C.

Scheme 1



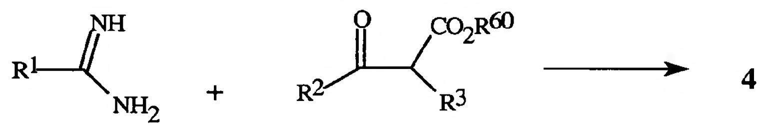
Compounds of Formula **2** can be prepared from hydroxy compounds of Formula **4** (which may exist in the keto form) by reaction with a chlorination reagent such as phosphorous oxychloride or thionyl chloride, optionally in the presence of a base such as *N*,*N*-dimethylaniline as shown in Scheme 2. The reaction can be run neat or in the presence of a solvent such as *N*,*N*-dimethylformamide at temperatures ranging from room temperature to 120 °C.

Scheme 2



Compounds of Formula **4** can be prepared by the condensation of amidines (or isoureas, isothioureas or guanidines) of Formula **5** with keto esters of Formula **6** in solvents such as methanol or ethanol at temperatures ranging from room temperature to the reflux temperature of the solvent as shown in Scheme 3. Optionally a base such as a metal alkoxide or 1,1,3,3-tetramethylguanidine may be employed.

Scheme 3



5 **6**

wherein R^{60} is a carbon moiety such as alkyl, preferably C_1–C_2 alkyl.

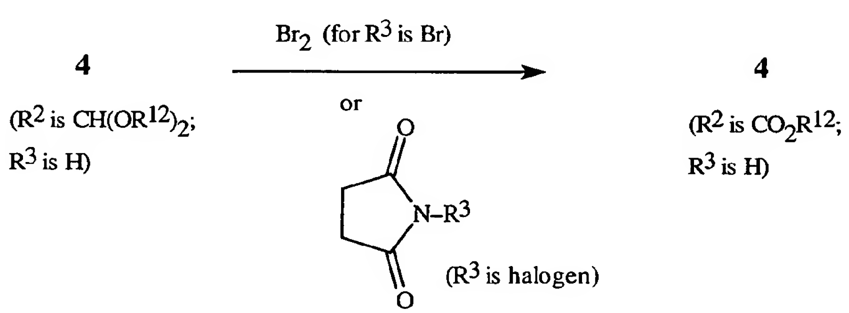
Compounds of Formula **4** wherein R^3 is a halogen can be prepared from compounds of Formula **4** where R^3 is hydrogen by reaction with a halogen such as bromine or a halogenating reagent such as an *N*-halosuccinimide in a variety of solvents including acetic acid, *N,N*-dimethylformamide, dichloromethane and carbon tetrachloride at temperatures ranging from 0–100 °C as shown in Scheme 4.

Scheme 4

$$\underset{(R^3 \text{ is H})}{\mathbf{4}} \xrightarrow{\text{halogenating reagent}} \underset{(R^3 \text{ is halogen})}{\mathbf{4}}$$

A particularly useful preparation of compounds of Formula **4** wherein R^3 is a halogen and R^2 is CO_2R^{12} is the reaction of compounds of Formula **4** where R^3 is hydrogen and R^2 is $CH(OR^{12})_2$ with a halogenating reagent and oxidizing reagent such as an *N*-halosuccinimide or bromine (when R^3 is bromine) in a solvent such as dichloromethane, trichloromethane or tetrachloromethane at temperatures ranging from room temperature to the reflux temperature of the solvent as shown in Scheme 5.

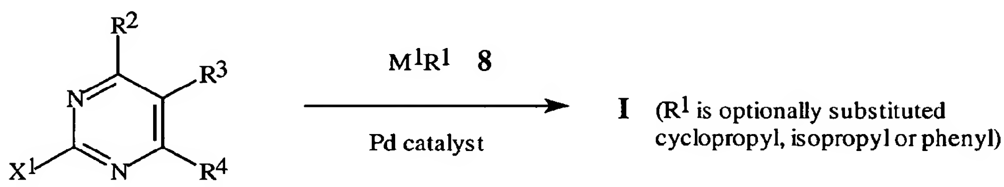
Scheme 5



Compounds of Formula **5** and **6** are either commercially available or can be prepared by known methods. (For example see: P. J. Dunn in *Comprehensive Organic Functional Group Transformations*, A. R. Katritzky, O. Meth-Cohn, C.W. Rees Eds, Pergamon Press; Oxford, 1995; vol. 5, pp.741–782; T.L. Gillchrist in *Comprehensive Organic Functional Group Transformations*, A. R. Katritzky, O. Meth-Cohn, C.W. Rees Eds., Pergamon Press; Oxford, 1995; vol. 6, pp. 601–637 and B. R. Davis, P. J. Garratt in *Comprehensive Organic Synthesis*, B. M. Trost Ed., Pergamom Press; Oxford, 1991; vol. 2, pp. 795–803.)

Alternatively compounds of Formula **I** wherein R^1 is an optionally substituted cyclopropyl, isopropyl or phenyl group can be prepared from corresponding compounds of Formula **7** wherein X^1 is a leaving group, such as a halogen or alkylsulfonyl group (e.g., methanesulfonyl, trifluoromethanesulfonyl, benzenesulfonyl), as shown in Scheme 6.

Scheme 6



7

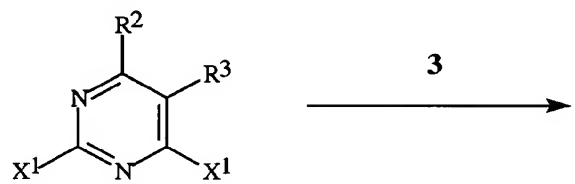
wherein M^1 is $B(OH)_2$, $Sn(n\text{-}Bu)_3$, MgX^1 or ZnX^1; R^1 is optionally substituted cyclopropyl, optionally substituted isopropyl or optionally substituted phenyl; and X^1 is a leaving group.

This method involves palladium-catalyzed reaction of a compound of Formula **7** with a compound of Formula **8** in the form of a boronic acid (e.g., M^1 is $B(OH)_2$), an organotin reagent (e.g., M^1 is $Sn(n\text{-}Bu)_3$), a Grignard reagent (e.g., M^1 is MgX^1) or an organozinc reagent (e.g., M^1 is ZnX^1). (For example see: N. Ali, A. McKillop, M. Mitchell, R. Rebelo, A. Ricardo, P. Wallbank, *Tetrahedron*, **1992**, *48*, 2273, J. Solberg, K. Jan, *Acta Chem. Scand.*, **1989**, *43*, 62, Undheim, V. Bonnet, F. Mongin, F. Trécourt, G. Quéguiner and P. Knochel, *Tetrahedron*, **2002**, *58*, 4429.)

Compounds of Formula **I** wherein R^1 is OR^8, SR^9 or $N(R^{10})R^{11}$ can be prepared by treating corresponding compounds of Formula **7** with M^2OR^8 (**9**), M^2SR^9 (**10**) or $HN(R^{10})R^{11}$ (**11**), respectively, wherein M^2 is typically an alkali metal in the form of a cation (e.g., Li, Na, K, Cs) or a quaternary ammonium (e.g., $(n\text{-}Bu)_4N$). This type of reaction is well known the art. The reaction with the amine of Formula **11** can be conveniently conducted in the presence of excess amine if the amine is inexpensive and of low molecular weight. Otherwise good yields can be conveniently obtained from a equimolar amount or slight excess of the amine of Formula **11** in the presence of another base or acid-scavenger (e.g., triethylamine, K_2CO_3) not reactive with the compound of Formula **7**.

Compounds of Formula **7** wherein X^1 is a halogen can be prepared from dihalo compounds of Formula **12** with an amine of Formula **3** optionally catalyzed by a base such as triethylamine or potassium carbonate in a variety of solvents including tetrahydrofuran and dichloromethane at temperatures ranging from 0 °C to the reflux temperature of the solvent as shown in Scheme 7.

Scheme 7



7 (X^1 is halogen)

12 (X^1 is halogen)

Compounds of Formula **12** can be prepared by known methods. (For example, see Gershon, *J. Org. Chem.*, **1962**, *27*, 3507.)

It is recognized that some reagents and reaction conditions described above for preparing compounds of Formula **I** may not be compatible with certain functionalities present in the intermediates. In these instances, the incorporation of protection/deprotection sequences or functional group interconversions into the synthesis will aid in obtaining the desired products. The use and choice of the protecting groups will be apparent to one skilled in chemical synthesis (see, for example, T. W. Greene, P. G. M. Wuts, *Protective Groups in Organic Synthesis*, 2nd ed.; Wiley: New York, 1991). One skilled in the art will recognize that, in some cases, after the introduction of a given reagent as it is depicted in any individual scheme, it may be necessary to perform additional routine synthetic steps not described in detail to complete the synthesis of compounds of Formula **I**. One skilled in the art will also recognize that it may be necessary to perform a combination of the steps illustrated in the above schemes in an order other than that implied by the particular sequence presented to prepare the compounds of Formula **I**.

One skilled in the art will also recognize that compounds of Formula **I** and the intermediates described herein can be subjected to various electrophilic, nucleophilic, radical, organometallic, oxidation, and reduction reactions to add substituents or modify existing substituents.

Without further elaboration, it is believed that one skilled in the art using the preceding description can utilize the present invention to its fullest extent. The following Examples are, therefore, to be construed as merely illustrative, and not limiting of the disclosure in any way whatsoever. Steps in the following Examples illustrate a procedure for each step in an overall synthetic transformation, and the starting material for each step may not have necessarily been prepared by a particular preparative run whose procedure is described in

other Examples or Steps. Percentages are by weight except for chromatographic solvent mixtures or where otherwise indicated. Parts and percentages for chromatographic solvent mixtures are by volume unless otherwise indicated. ^{1}H NMR spectra are reported in ppm downfield from tetramethylsilane; "s" means singlet, "d" means doublet, "t" means triplet, "q" means quartet, "m" means multiplet, "dd" means doublet of doublets, "ddd" means doublet of doublets of doublets, "dt" means doublet of triplets, "dq" means doublet of quartets, "br s" means broad singlet, "br d" means broad doublet.

EXAMPLE 1

Preparation of ethyl 6-amino-5-bromo-2-cyclopropyl-4-pyrimidinecarboxylate (Compound 1) and methyl 6-amino-5-bromo-2-cyclopropyl-4-pyrimidinecarboxylate (Compound 2)

Step A: Preparation of 2-cyclopropyl-6-(diethoxymethyl)-4(1*H*)-pyrimidinone

To a mixture of ethyl 4,4-diethoxy-3-oxobutanoate (prepared according to the method of E. Graf, R. Troschutz, *Synthesis*, **1999**, *7*, 1216; 10.0 g, 46 mmol) and cyclopropanecarboximidamide monohydrochloride (Lancaster Synthesis, 5.0 g, 41 mmol) in methanol (100 mL) was added a methanol solution of sodium methoxide (5.4 M, 8.4 mL, 46 mmol). The reaction mixture was stirred overnight. The solvent was removed with a rotary evaporator. Dichloromethane was added and the mixture was filtered. The solvent from the filtrate was removed with a rotary evaporator. The residue was purified by medium pressure liquid chromatography (MPLC) (35→100% ethyl acetate in hexanes as eluant) to afford the title compound as a white solid (4.67 g).

^{1}H NMR ($CDCl_3$) δ 6.55 (s, 1H), 5.10 (s, 1H), 3.61 (m, 4H), 1.91 (m, 1H), 1.23 (m, 8H), 1.09 (m, 2H).

Additionally 3.24 g of an undehydrated product was obtained. This material could be converted to the title compound by refluxing it in methanol with a catalytic amount of pyridinium *p*-toluenesulfonate.

Step B: Preparation of ethyl 5-bromo-2-cyclopropyl-1,6-dihydro-6-oxo-4-pyrimidinecarboxylate

To a solution of 2-cyclopropyl-6-(diethoxymethyl)-4(1*H*)-pyrimidinone (i.e. the title product of Step A) (2.9 g, 12.1 mmol) in dichloromethane (75 mL) was added *N*-bromosuccinimide (4.76 g, 26.8 mmol). The reaction mixture was stirred overnight. The solvent was removed with a rotary evaporator. The residue was purified by MPLC (1→4% methanol in dichloromethane as eluant) to afford the title compound as a white solid (2.68 g).

^{1}H NMR ($CDCl_3$) δ 4.43 (q, 2H), 1.90 (m, 1H), 1.41 (t, 3H), 1.30 (m, 2H), 1.20 (m, 2H).

Step C: Preparation of ethyl 6-amino-5-bromo-2-cyclopropyl-4-pyrimidinecarboxylate and methyl 6-amino-5-bromo-2-cyclopropyl-4-pyrimidinecarboxylate

To a solution of ethyl 5-bromo-2-cyclopropyl-1,6-dihydro-6-oxo-4-pyrimidinecarboxylate (i.e. the product of Step B) (1.07 g, 3.7 mmol) in *N,N*-dimethylformamide (15 mL) was added thionyl chloride (0.54 mL, 7.5 mmol). The reaction mixture was stirred for 2 h. The solvent was removed with a rotary evaporator. The residue was dissolved in dichloromethane, washed with saturated aqueous sodium bicarbonate and dried (Na_2SO_4). The solvent was removed with a rotary evaporator. The residue was dissolved in tetrahydrofuran (2 mL), and a methanolic solution of ammonia (7 N, 2 mL) was added. The reaction mixture was placed in a sealed vial and heated in a microwave reactor at 125 °C for 2h. The reaction mixture was allowed to stand over the weekend. Dichloromethane was added and the reaction mixture was filtered. The solvent was removed with a rotary evaporator. The residue was purified by MPLC (10→30% ethyl acetate in hexanes as eluant) to afford the title product, a compound of the present invention, as a white solid (0.52 g).

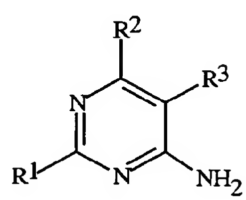
^{1}H NMR ($CDCl_3$) δ 5.40 (br s, 2H), 4.44 (q, 2H), 2.05 (m, 1H), 1.01 (t, 3H), 1.05 (m, 2H), 0.99 (m, 2H).

Also isolated by from the MPLC purification was the corresponding methyl ester, i.e. methyl 6-amino-5-bromo-2-cyclopropyl-4-pyrimidinecarboxylate, a further compound of the present invention, as a white solid (0.06 g).

^{1}H NMR ($CDCl_3$) δ 5.40 (br s, 2H), 3.97 (s, 3H) 2.05 (m, 1H), 1.05 (m, 2H), 0.99 (m, 2H).

By the procedures described herein together with methods known in the art, the following compounds of Tables 1 to 4 can be prepared. The following abbreviations are used in the Tables which follow: *t* means tertiary, *i* means iso, Me means methyl, Et means ethyl, Pr means propyl, *i*-Pr means isopropyl, Bu means butyl, *t*-Bu means *tert*-butyl, CN means cyano, and $S(O)_2Me$ means methylsulfonyl.

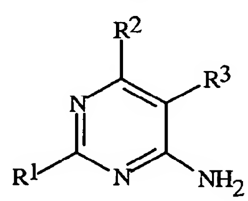
TABLE 1



R^1 is cyclopropyl; R^3 is Cl.	R^1 is cyclopropyl; R^3 is F.	R^1 is cyclopropyl; R^3 is Br.	R^1 is cyclopropyl; R^3 is I.
R^2	R^2	R^2	R^2
CO_2H	CO_2H	CO_2H	CO_2H
CO_2Me	CO_2Me	CO_2Me	CO_2Me

R^1 is cyclopropyl; R^3 is Cl.	R^1 is cyclopropyl; R^3 is F.	R^1 is cyclopropyl; R^3 is Br.	R^1 is cyclopropyl; R^3 is I.
<u>R^2</u>	<u>R^2</u>	<u>R^2</u>	<u>R^2</u>
CO_2Et	CO_2Et	CO_2Et	CO_2Et
CO_2Pr	CO_2Pr	CO_2Pr	CO_2Pr
CO_2*i*Pr	CO_2*i*Pr	CO_2*i*Pr	CO_2*i*Pr
CO_2*t*-Bu	CO_2*t*-Bu	CO_2*t*-Bu	CO_2*t*-Bu
CO_2cyclohexyl	CO_2cyclohexyl	CO_2cyclohexyl	CO_2cyclohexyl
CO_2hexyl	CO_2hexyl	CO_2hexyl	CO_2hexyl
CO_2CH_2cyclohexyl	CO_2CH_2cyclohexyl	CO_2CH_2cyclohexyl	CO_2CH_2cyclohexyl
CO_2CH_2Ph	CO_2CH_2Ph	CO_2CH_2Ph	CO_2CH_2Ph
$CO_2CH(Me)Ph$	$CO_2CH(Me)Ph$	$CO_2CH(Me)Ph$	$CO_2CH(Me)Ph$
CO_2CH_2(4-Cl-Ph)	CO_2CH_2(4-Cl-Ph)	CO_2CH_2(4-Cl-Ph)	CO_2CH_2(4-Cl-Ph)
CO_2CH_2(3-F-Ph)	CO_2CH_2(3-F-Ph)	CO_2CH_2(3-F-Ph)	CO_2CH_2(3-F-Ph)
$CO_2CH_2CH_2NMe_2$	$CO_2CH_2CH_2NMe_2$	$CO_2CH_2CH_2NMe_2$	$CO_2CH_2CH_2NMe_2$
$CO_2CH_2CH_2OMe$	$CO_2CH_2CH_2OMe$	$CO_2CH_2CH_2OMe$	$CO_2CH_2CH_2OMe$
CO_2CH_2(3-oxetanyl)	CO_2CH_2(3-oxetanyl)	CO_2CH_2(3-oxetanyl)	CO_2CH_2(3-oxetanyl)
CH_2OH	CH_2OH	CH_2OH	CH_2OH
CH_2OMe	CH_2OMe	CH_2OMe	CH_2OMe
CHO	CHO	CHO	CHO
C(=NOH)H	C(=NOH)H	C(=NOH)H	C(=NOH)H
C(=NOMe)H	C(=NOMe)H	C(=NOMe)H	C(=NOMe)H
CH_2CO_2Me	CH_2CO_2Me	CH_2CO_2Me	CH_2CO_2Me
$C(=O)NH_2$	$C(=O)NH_2$	$C(=O)NH_2$	$C(=O)NH_2$
C(=O)NHMe	C(=O)NHMe	C(=O)NHMe	C(=O)NHMe
$C(=O)NMe_2$	$C(=O)NMe_2$	$C(=O)NMe_2$	$C(=O)NMe_2$

<u>TABLE 2</u>



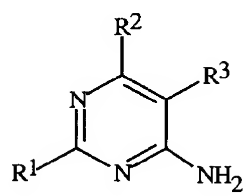
R^2 is CO_2H; R^3 is Cl.	R^2 is CO_2Me; R^3 is Cl.	R^2 is CO_2Et; R^3 is Cl.
<u>R^1</u>	<u>R^1</u>	<u>R^1</u>
i-Pr	*i*-Pr	*i*-Pr
1-Me-cyclopropyl	1-Me-cyclopropyl	1-Me-cyclopropyl
2-Me-cyclopropyl	2-Me-cyclopropyl	2-Me-cyclopropyl

R^2 is CO_2H; R^3 is Cl.	R^2 is CO_2Me; R^3 is Cl.	R^2 is CO_2Et; R^3 is Cl.
$\underline{R^1}$	$\underline{R^1}$	$\underline{R^1}$
2-F-cyclopropyl	2-F-cyclopropyl	2-F-cyclopropyl
2-Cl-cyclopropyl	2-Cl-cyclopropyl	2-Cl-cyclopropyl
2,2-di-F-cyclopropyl	2,2-di-F-cyclopropyl	2,2-di-F-cyclopropyl
2,2-di-Cl-cyclopropyl	2,2-di-Cl-cyclopropyl	2,2-di-Cl-cyclopropyl
2,3-di-F-cyclopropyl	1,2-di-F-cyclopropyl	1,2-di-F-cyclopropyl
2,2,3,3-tetra-F-cyclopropyl	2,2,3,3-tetra-F-cyclopropyl	2,2,3,3-tetra-F-cyclopropyl
1,2,2,3,3-penta-F-cyclopropyl	1,2,2,3,3-penta-F-cyclopropyl	1,2,2,3,3-penta-F-cyclopropyl
Ph	Ph	Ph
4-Cl-Ph	4-Cl-Ph	4-Cl-Ph
4-F-Ph	4-F-Ph	4-F-Ph
3-OMe-Ph	3-OMe-Ph	3-OMe-Ph
Cl	Cl	Cl
OMe	OMe	OMe
OEt	OEt	OEt
OPh	OPh	OPh
O(3-Cl-Ph)	O(3-Cl-Ph)	O(3-Cl-Ph)
O(3,5-di-Cl-Ph)	O(3,5-di-Cl-Ph)	O(3,5-di-Cl-Ph)
SMe	SMe	SMe
SEt	SEt	SEt
NHMe	NHMe	NHMe
NMe_2	NMe_2	NMe_2
1-aziridinyl	1-aziridinyl	1-aziridinyl

R^2 is CO_2H; R^3 is Br.	R^2 is CO_2Me; R^3 is Br.	R^2 is CO_2Et; R^3 is Br.
$\underline{R^1}$	$\underline{R^1}$	$\underline{R^1}$
i-Pr	*i*-Pr	*i*-Pr
1-Me-cyclopropyl	1-Me-cyclopropyl	1-Me-cyclopropyl
2-Me-cyclopropyl	2-Me-cyclopropyl	2-Me-cyclopropyl
2-F-cyclopropyl	2-F-cyclopropyl	2-F-cyclopropyl
2-Cl-cyclopropyl	2-Cl-cyclopropyl	2-Cl-cyclopropyl
2,2-di-F-cyclopropyl	2,2-di-F-cyclopropyl	2,2-di-F-cyclopropyl
2,2-di-Cl-cyclopropyl	2,2-di-Cl-cyclopropyl	2,2-di-Cl-cyclopropyl
1,2-di-F-cyclopropyl	1,2-di-F-cyclopropyl	1,2-di-F-cyclopropyl
2,2,3,3-tetra-F-cyclopropyl	2,2,3,3-tetra-F-cyclopropyl	2,2,3,3-tetra-F-cyclopropyl
1,2,2,3,3-penta-F-cyclopropyl	1,2,2,3,3-penta-F-cyclopropyl	1,2,2,3,3-penta-F-cyclopropyl
Ph	Ph	Ph

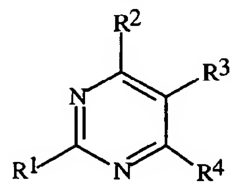
R^2 is CO_2H; R^3 is Br.	R^2 is CO_2Me; R^3 is Br.	R^2 is CO_2Et; R^3 is Br.
R^1	R^1	R^1
4-Cl-Ph	4-Cl-Ph	4-Cl-Ph
4-F-Ph	4-F-Ph	4-F-Ph
3-OMe-Ph	3-OMe-Ph	3-OMe-Ph
Cl	Cl	Cl
OMe	OMe	OMe
OEt	OEt	OEt
OPh	OPh	OPh
O(3-Cl-Ph)	O(3-Cl-Ph)	O(3-Cl-Ph)
O(3,5-di-Cl-Ph)	O(3,5-di-Cl-Ph)	O(3,5-di-Cl-Ph)
SEt	SEt	SEt
NHMe	NHMe	NHMe
NMe_2	NMe_2	NMe_2
1-aziridinyl	1-aziridinyl	1-aziridinyl

TABLE 3



R^1 is cyclopropyl; R^2 is CO_2Me.	R^1 is cyclopropyl; R^2 is CO_2Et.
R^3	R^3
CN	CN
NO_2	NO_2
OMe	OMe
SMe	SMe
NH_2	NH_2
NHMe	NHMe
NMe_2	NMe_2

TABLE 4



R^1 is cyclopropyl; R^2 is CO_2Me; R^3 is Cl.	R^1 is cyclopropyl; R^2 is CO_2Me; R^3 is Br.	R^1 is cyclopropyl; R^2 is CO_2Et; R^3 is Cl.	R^1 is cyclopropyl; R^2 is CO_2Et; R^3 is Br.
R^4	R^4	R^4	R^4
NO_2	NO_2	NO_2	NO_2
NHMe	NHMe	NHMe	NHMe
NMe_2	NMe_2	NMe_2	NMe_2
$N(-CH_2CH_2OCH_2CH_2-)$	$N(-CH_2CH_2OCH_2CH_2-)$	$N(-CH_2CH_2OCH_2CH_2-)$	$N(-CH_2CH_2OCH_2CH_2-)$
NHC(=O)Me	NHC(=O)Me	NHC(=O)Me	NHC(=O)Me
NHC(=O)OMe	NHC(=O)OMe	NHC(=O)OMe	NHC(=O)OMe
$NHS(O)_2Me$	$NHS(O)_2Me$	$NHS(O)_2Me$	$NHS(O)_2Me$
$NHNH_2$	$NHNH_2$	$NHNH_2$	$NHNH_2$
$NHNO_2$	$NHNO_2$	$NHNO_2$	$NHNO_2$
$N=CHNMe_2$	$N=CHNMe_2$	$N=CHNMe_2$	$N=CHNMe_2$
NHOH	NHOH	NHOH	NHOH
NHOMe	NHOMe	NHOMe	NHOMe
$NHCH_2CO_2Me$	$NHCH_2CO_2Me$	$NHCH_2CO_2Me$	$NHCH_2CO_2Me$
$NHCH_2CO_2Et$	$NHCH_2CO_2Et$	$NHCH_2CO_2Et$	$NHCH_2CO_2Et$
$NHCH_2CH_2OH$	$NHCH_2CH_2OH$	$NHCH_2CH_2OH$	$NHCH_2CH_2OH$
$NHCH_2CH_2OMe$	$NHCH_2CH_2OMe$	$NHCH_2CH_2OMe$	$NHCH_2CH_2OMe$
$NHCH_2CH_2NMe_2$	$NHCH_2CH_2NMe_2$	$NHCH_2CH_2NMe_2$	$NHCH_2CH_2NMe_2$

Formulation/Utility

Compounds of this invention will generally be used as a formulation or composition with an agriculturally suitable carrier comprising at least one of a liquid diluent, a solid diluent or a surfactant. The formulation or composition ingredients are selected to be consistent with the physical properties of the active ingredient, mode of application and environmental factors such as soil type, moisture and temperature. Useful formulations include liquids such as solutions (including emulsifiable concentrates), suspensions, emulsions (including microemulsions and/or suspoemulsions) and the like which optionally can be thickened into gels. Useful formulations further include solids such as dusts, powders, granules, pellets, tablets, films (including seed coatings), and the like which can be water-dispersible ("wettable") or water-soluble. Active ingredient can be (micro)encapsulated and further formed into a suspension or solid formulation; alternatively

the entire formulation of active ingredient can be encapsulated (or "overcoated"). Encapsulation can control or delay release of the active ingredient. Sprayable formulations can be extended in suitable media and used at spray volumes from about one to several hundred liters per hectare. High-strength compositions are primarily used as intermediates for further formulation.

The formulations will typically contain effective amounts of active ingredient, diluent and surfactant within the following approximate ranges which add up to 100 percent by weight.

	Weight Percent		
	Active Ingredient	Diluent	Surfactant
Water-Dispersible and Water-soluble Granules, Tablets and Powders.	0.001–90	0–99.999	0–15
Suspensions, Emulsions, Solutions (including Emulsifiable Concentrates)	1–50	40–99	0–50
Dusts	1–25	70–99	0–5
Granules and Pellets	0.001–99	5–99.999	0–15
High Strength Compositions	90–99	0–10	0–2

Typical solid diluents are described in Watkins, et al., *Handbook of Insecticide Dust Diluents and Carriers*, 2nd Ed., Dorland Books, Caldwell, New Jersey. Typical liquid diluents are described in Marsden, *Solvents Guide*, 2nd Ed., Interscience, New York, 1950. *McCutcheon's Detergents and Emulsifiers Annual*, Allured Publ. Corp., Ridgewood, New Jersey, as well as Sisely and Wood, *Encyclopedia of Surface Active Agents*, Chemical Publ. Co., Inc., New York, 1964, list surfactants and recommended uses. All formulations can contain minor amounts of additives to reduce foam, caking, corrosion, microbiological growth and the like, or thickeners to increase viscosity.

Surfactants include, for example, polyethoxylated alcohols, polyethoxylated alkylphenols, polyethoxylated sorbitan fatty acid esters, dialkyl sulfosuccinates, alkyl sulfates, alkylbenzene sulfonates, organosilicones, *N,N*-dialkyltaurates, lignin sulfonates, naphthalene sulfonate formaldehyde condensates, polycarboxylates, glycerol esters, poly-oxyethylene/polyoxypropylene block copolymers, and alkylpolyglycosides where the number of glucose units, referred to as degree of polymerization (D.P.), can range from 1 to 3 and the alkyl units can range from C_6 to C_{14} (see *Pure and Applied Chemistry 72*, 1255–1264). Solid diluents include, for example, clays such as bentonite, montmorillonite, attapulgite and kaolin, starch, sugar, silica, talc, diatomaceous earth, urea, calcium carbonate, sodium carbonate and bicarbonate, and sodium sulfate. Liquid diluents include, for example,

water, *N,N*-dimethylformamide, dimethyl sulfoxide, *N*-alkylpyrrolidone, ethylene glycol, polypropylene glycol, propylene carbonate, dibasic esters, paraffins, alkylbenzenes, alkylnaphthalenes, glycerine, triacetine, oils of olive, castor, linseed, tung, sesame, corn, peanut, cotton-seed, soybean, rape-seed and coconut, fatty acid esters, ketones such as cyclohexanone, 2-heptanone, isophorone and 4-hydroxy-4-methyl-2-pentanone, acetates such as hexyl acetate, heptyl acetate and octyl acetate, and alcohols such as methanol, cyclohexanol, decanol, benzyl and tetrahydrofurfuryl alcohol.

Useful formulations of this invention may also contain materials well known to those skilled in the art as formulation aids such as antifoams, film formers and dyes. Antifoams can include water dispersible liquids comprising polyorganosiloxanes like Rhodorsil® 416. The film formers can include polyvinyl acetates, polyvinyl acetate copolymers, polyvinylpyrrolidone-vinyl acetate copolymer, polyvinyl alcohols, polyvinyl alcohol copolymers and waxes. Dyes can include water dispersible liquid colorant compositions like Pro-lzed® Colorant Red. One skilled in the art will appreciate that this is a non-exhaustive list of formulation aids. Suitable examples of formulation aids include those listed herein and those listed in *McCutcheon's 2001, Volume 2: Functional Materials* published by MC Publishing Company and PCT Publication WO 03/024222.

Solutions, including emulsifiable concentrates, can be prepared by simply mixing the ingredients. Dusts and powders can be prepared by blending and, usually, grinding as in a hammer mill or fluid-energy mill. Suspensions are usually prepared by wet-milling; see, for example, U.S. 3,060,084. Granules and pellets can be prepared by spraying the active material upon preformed granular carriers or by agglomeration techniques. See Browning, "Agglomeration", *Chemical Engineering*, December 4, 1967, pp 147–48, *Perry's Chemical Engineer's Handbook*, 4th Ed., McGraw-Hill, New York, 1963, pages 8–57 and following, and WO 91/13546. Pellets can be prepared as described in U.S. 4,172,714. Water-dispersible and water-soluble granules can be prepared as taught in U.S. 4,144,050, U.S. 3,920,442 and DE 3,246,493. Tablets can be prepared as taught in U.S. 5,180,587, U.S. 5,232,701 and U.S. 5,208,030. Films can be prepared as taught in GB 2,095,558 and U.S. 3,299,566.

For further information regarding the art of formulation, see T. S. Woods, "The Formulator's Toolbox – Product Forms for Modern Agriculture" in *Pesticide Chemistry and Bioscience, The Food–Environment Challenge*, T. Brooks and T. R. Roberts, Eds., Proceedings of the 9th International Congress on Pesticide Chemistry, The Royal Society of Chemistry, Cambridge, 1999, pp. 120–133. See also U.S. 3,235,361, Col. 6, line 16 through Col. 7, line 19 and Examples 10–41; U.S. 3,309,192, Col. 5, line 43 through Col. 7, line 62 and Examples 8, 12, 15, 39, 41, 52, 53, 58, 132, 138–140, 162–164, 166, 167 and 169–182; U.S. 2,891,855, Col. 3, line 66 through Col. 5, line 17 and Examples 1–4; Klingman, *Weed Control as a Science*, John Wiley and Sons, Inc., New York, 1961, pp 81–96; Hance et al.,

Weed Control Handbook, 8th Ed., Blackwell Scientific Publications, Oxford, 1989; and *Developments in formulation technology*, PJB Publications, Richmond, UK, 2000.

In the following Examples, all percentages are by weight and all formulations are prepared in conventional ways. Compound numbers refer to compounds in Index Tables A–B.

Example A

High Strength Concentrate

Compound 1	98.5%
silica aerogel	0.5%
synthetic amorphous fine silica	1.0%.

Example B

Wettable Powder

Compound 2	65.0%
dodecylphenol polyethylene glycol ether	2.0%
sodium ligninsulfonate	4.0%
sodium silicoaluminate	6.0%
montmorillonite (calcined)	23.0%.

Example C

Granule

Compound 4	10.0%
attapulgite granules (low volatile matter, 0.71/0.30 mm; U.S.S. No. 25–50 sieves)	90.0%.

Example D

Aqueous Suspension

Compound 9	25.0%
hydrated attapulgite	3.0%
crude calcium ligninsulfonate	10.0%
sodium dihydrogen phosphate	0.5%
water	61.5%.

Example E

Extruded Pellet

Compound 1	25.0%
anhydrous sodium sulfate	10.0%
crude calcium ligninsulfonate	5.0%
sodium alkylnaphthalenesulfonate	1.0%
calcium/magnesium bentonite	59.0%.

Example F

Microemulsion

Compound 2	1.0%
triacetine	30.0%
C_8–C_{10} alkylpolyglycoside	30.0%
glyceryl monooleate	19.0%
water	20.0%.

Test results indicate that the compounds of the present invention are highly active preemergent and/or postemergent herbicides and/or plant growth regulants. Many of them have utility for broad-spectrum pre- and/or postemergence weed control in areas where complete control of all vegetation is desired such as around fuel storage tanks, industrial storage areas, parking lots, drive-in theaters, air fields, river banks, irrigation and other waterways, around billboards and highway and railroad structures. Many of the compounds of this invention, by virtue of selective metabolism in crops versus weeds, or by selective activity at the locus of physiological inhibition in crops and weeds, or by selective placement on or within the environment of a mixture of crops and weeds, are useful for the selective control of grass and broadleaf weeds within a crop/weed mixture. One skilled in the art will recognize that the preferred combination of these selectivity factors within a compound or group of compounds can readily be determined by performing routine biological and/or biochemical assays. Compounds of this invention may show tolerance to important agronomic crops including, but is not limited to, alfalfa, barley, cotton, wheat, rape, sugar beets, corn (maize), sorghum, soybeans, rice, oats, peanuts, vegetables, tomato, potato, perennial plantation crops including coffee, cocoa, oil palm, rubber, sugarcane, citrus, grapes, fruit trees, nut trees, banana, plantain, pineapple, hops, tea and forests such as eucalyptus and conifers (e.g., loblolly pine), and turf species (e.g., Kentucky bluegrass, St. Augustine grass, Kentucky fescue and Bermuda grass). Those skilled in the art will appreciate that not all compounds are equally effective against all weeds. Alternatively, the subject compounds are useful to modify plant growth.

As the compounds of the invention have both preemergent and postemergent herbicidal activity, to control undesired vegetation by killing or injuring the vegetation or reducing its growth, the compounds can be usefully applied by a variety of methods involving contacting a herbicidally effective amount of a compound of the invention, or a composition comprising said compound and at least one of a surfactant, a solid diluent or a liquid diluent, to the foliage or other part of the undesired vegetation or to the environment of the undesired vegetation such as the soil or water in which the undesired vegetation is growing or which surrounds the seed or other propagule of the undesired vegetation.

A herbicidally effective amount of the compounds of this invention is determined by a number of factors. These factors include: formulation selected, method of application,

amount and type of vegetation present, growing conditions, etc. In general, a herbicidally effective amount of compounds of this invention is about 0.0001 to 20 kg/ha with a preferred range of about 0.001 to 5 kg/ha and a more preferred range of about 0.004 to 3 kg/ha. One skilled in the art can easily determine the herbicidally effective amount necessary for the desired level of weed control.

Compounds of this invention can be used alone or in combination with other commercial herbicides, insecticides and fungicides, and other agricultural chemicals such as fertilizers. Mixtures of the compounds of the invention with other herbicides can broaden the spectrum of activity against additional weed species, and suppress the proliferation of any resistant biotypes. A mixture of one or more of the following herbicides with a compound of this invention may be particularly useful for weed control: acetochlor, acifluorfen and its sodium salt, aclonifen, acrolein (2-propenal), alachlor, alloxydim, ametryn, amicarbazone, amidosulfuron, aminopyralid, amitrole, ammonium sulfamate, anilofos, asulam, atrazine, azimsulfuron, beflubutamid, benazolin, benazolin-ethyl, benfluralin, benfuresate, bensulfuron-methyl, bensulide, bentazone, benzobicyclon, benzofenap, bifenox, bilanafos, bispyribac and its sodium salt, bromacil, bromobutide, bromofenoxim, bromoxynil, bromoxynil octanoate, butachlor, butafenacil, butamifos, butralin, butroxydim, butylate, cafenstrole, carbetamide, carfentrazone-ethyl, catechin, chlomethoxyfen, chloramben, chlorbromuron, chlorflurenol-methyl, chloridazon, chlorimuron-ethyl, chlorotoluron, chlorpropham, chlorsulfuron, chlorthal-dimethyl, chlorthiamid, cinidon-ethyl, cinmethylin, cinosulfuron, clethodim, clodinafop-propargyl, clomazone, clomeprop, clopyralid, clopyralid-olamine, cloransulam-methyl, cumyluron, cyanazine, cycloate, cyclosulfamuron, cycloxydim, cyhalofop-butyl, 2,4-D and its butotyl, butyl, isoctyl and isopropyl esters and its dimethylammonium, diolamine and trolamine salts, daimuron, dalapon, dalapon-sodium, dazomet, 2,4-DB and its dimethylammonium, potassium and sodium salts, desmedipham, desmetryn, dicamba and its diglycolammonium, dimethylammonium, potassium and sodium salts, dichlobenil, dichlorprop, diclofop-methyl, diclosulam, difenzoquat metilsulfate, diflufenican, diflufenzopyr, dimefuron, dimepiperate, dimethachlor, dimethametryn, dimethenamid, dimethenamid-P, dimethipin, dimethylarsinic acid and its sodium salt, dinitramine, dinoterb, diphenamid, diquat dibromide, dithiopyr, diuron, DNOC, endothal, EPTC, esprocarb, ethalfluralin, ethametsulfuron-methyl, ethofumesate, ethoxyfen, ethoxysulfuron, etobenzanid, fenoxaprop-ethyl, fenoxaprop-P-ethyl, fentrazamide, fenuron, fenuron-TCA, flamprop-methyl, flamprop-M-isopropyl, flamprop-M-methyl, flazasulfuron, florasulam, fluazifop-butyl, fluazifop-P-butyl, flucarbazone, fluchloralin, flufenacet, flufenpyr, flufenpyr-ethyl, flumetsulam, flumiclorac-pentyl, flumioxazin, fluometuron, fluoroglycofen-ethyl, flupyrsulfuron-methyl and its sodium salt, flurenol, flurenol-butyl, fluridone, flurochloridone, fluroxypyr, flurtamone, fluthiacet-methyl, fomesafen, foramsulfuron, fosamine-ammonium, glufosinate,

glufosinate-ammonium, glyphosate and its salts such as ammonium, isopropylammonium, potassium, sodium (including sesquisodium) and trimesium (alternatively named sulfosate), halosulfuron-methyl, haloxyfop-etotyl, haloxyfop-methyl, hexazinone, imazamethabenz-methyl, imazamox, imazapic, imazapyr, imazaquin, imazaquin-ammonium, imazethapyr, imazethapyr-ammonium, imazosulfuron, indanofan, iodosulfuron-methyl, ioxynil, ioxynil octanoate, ioxynil-sodium, isoproturon, isouron, isoxaben, isoxaflutole, isoxachlortole, isoxadifen, lactofen, lenacil, linuron, maleic hydrazide, MCPA and its dimethylammonium, potassium and sodium salts, MCPA-isoctyl, MCPA-thioethyl, MCPB and its sodium salt, MCPB-ethyl, mecoprop, mecoprop-P, mefenacet, mefluidide, mesosulfuron-methyl, mesotrione, metam-sodium, metamifop, metamitron, metazachlor, methabenzthiazuron, methylarsonic acid and its calcium, monoammonium, monosodium and disodium salts, methyldymron, metobenzuron, metobromuron, metolachlor, S-metholachlor, metosulam, metoxuron, metribuzin, metsulfuron-methyl, molinate, monolinuron, naproanilide, napropamide, naptalam, neburon, nicosulfuron, norflurazon, orbencarb, oryzalin, oxadiargyl, oxadiazon, oxasulfuron, oxaziclomefone, oxyfluorfen, paraquat dichloride, pebulate, pelargonic acid, pendimethalin, penoxsulam, pentanochlor, pentoxazone, perfluidone, pethoxyamid, phenmedipham, picloram, picloram-potassium, picolinafen, piperofos, pretilachlor, primisulfuron-methyl, prodiamine, profoxydim, prometon, prometryn, propachlor, propanil, propaquizafop, propazine, propham, propisochlor, propoxycarbazone, propyzamide, prosulfocarb, prosulfuron, pyraclonil, pyraflufen-ethyl, pyrazogyl, pyrazolynate, pyrazoxyfen, pyrazosulfuron-ethyl, pyribenzoxim, pyributicarb, pyridate, pyriftalid, pyriminobac-methyl, pyrithiobac, pyrithiobac-sodium, quinclorac, quinmerac, quinoclamine, quizalofop-ethyl, quizalofop-P-ethyl, quizalofop-P-tefuryl, rimsulfuron, sethoxydim, siduron, simazine, simetryn, sulcotrione, sulfentrazone, sulfometuron-methyl, sulfosulfuron, 2,3,6-TBA, TCA, TCA-sodium, tebutam, tebuthiuron, tepraloxydim, terbacil, terbumeton, terbuthylazine, terbutryn, thenylchlor, thiazopyr, thifensulfuron-methyl, thiobencarb, tiocarbazil, tralkoxydim, tri-allate, triasulfuron, triaziflam, tribenuron-methyl, triclopyr, triclopyr-butotyl, triclopyr-triethylammonium, tridiphane, trietazine, trifloxysulfuron, trifluralin, triflusulfuron-methyl, tritosulfuron and vernolate. Other herbicides also include bioherbicides such as *Alternaria destruens* Simmons, *Colletotrichum gloeosporiodes* (Penz.) Penz. & Sacc., *Drechsiera monoceras* (MTB-951), *Myrothecium verrucaria* (Albertini & Schweinitz) Ditmar: Fries, *Phytophthora palmivora* (Butl.) Butl. and *Puccinia thlaspeos* Schub. Combinations of compounds of the invention with other herbicides can result in a greater-than-additive (i.e. synergistic) effect on weeds and/or a less-than-additive effect (i.e. safening) on crops or other desirable plants. In certain instances, combinations with other herbicides having a similar spectrum of control but a different mode of action will be particularly advantageous for preventing the development of resistant weeds. Herbicidally

effective amounts of compounds of the invention as well as herbicidally effective amounts of other herbicides can be easily determined by one skilled in the art through simple experimentation.

Preferred for better control of undesired vegetation (e.g., lower use rate, broader spectrum of weeds controlled, or enhanced crop safety) or for preventing the development of resistant weeds are mixtures of a compound of this invention with a herbicide selected from the group consisting of ametryn, diuron, flupyrsulfuron-methyl (particularly flupyrsulfuron-methyl-sodium), glyphosate (particularly glyphosate-isopropylammonium, glyphosate-sodium, glyphosate-potassium, glyphosate-trimesium), glufosinate (particularly glufosinate-ammonium), hexazinone, isoproturon, metsulfuron-methyl, rimsulfuron, sulfometuron-methyl, terbacil, and paraquat. Specifically preferred mixtures (compound numbers refer to compounds in Index Tables A–B) are selected from the group: compound 1 and ametryn; compound 2 and ametryn; compound 4 and ametryn; compound 5 and ametryn; compound 9 and ametryn; compound 15 and ametryn; compound 16 and ametryn; compound 17 and ametryn; compound 1 and diuron; compound 2 and diuron; compound 4 and diuron; compound 5 and diuron; compound 9 and diuron; compound 15 and diuron; compound 16 and diuron; compound 17 and diuron; compound 1 and flupyrsulfuron-methyl; compound 2 and flupyrsulfuron-methyl; compound 4 and flupyrsulfuron-methyl; compound 5 and flupyrsulfuron-methyl; compound 9 and flupyrsulfuron-methyl; compound 15 and flupyrsulfuron-methyl; compound 16 and flupyrsulfuron-methyl; compound 17 and flupyrsulfuron-methyl; compound 1 and glyphosate; compound 2 and glyphosate; compound 4 and glyphosate; compound 5 and glyphosate; compound 9 and glyphosate; compound 15 and glyphosate; compound 16 and glyphosate; compound 17 and glyphosate; compound 1 and glufosinate; compound 2 and glufosinate; compound 4 and glufosinate; compound 5 and glufosinate; compound 9 and glufosinate; compound 15 and glufosinate; compound 16 and glufosinate; compound 17 and glufosinate; compound 1 and hexazinone; compound 2 and hexazinone; compound 4 and hexazinone; compound 5 and hexazinone; compound 9 and hexazinone; compound 15 and hexazinone; compound 16 and hexazinone; compound 17 and hexazinone; compound 1 and isoproturon; compound 2 and isoproturon; compound 4 and isoproturon; compound 5 and isoproturon; compound 9 and isoproturon; compound 15 and isoproturon; compound 16 and isoproturon; compound 17 and isoproturon; compound 1 and metsulfuron-methyl; compound 2 and metsulfuron-methyl; compound 4 and metsulfuron-methyl; compound 5 and metsulfuron-methyl; compound 9 and metsulfuron-methyl; compound 15 and metsulfuron-methyl; compound 16 and metsulfuron-methyl; compound 17 and metsulfuron-methyl; compound 1 and paraquat; compound 2 and paraquat; compound 4 and paraquat; compound 5 and paraquat; compound 9 and paraquat; compound 15 and paraquat; compound 16 and paraquat; compound 17 and paraquat; compound 1 and rimsulfuron; compound 2 and rimsulfuron;

compound 4 and rimsulfuron; compound 5 and rimsulfuron; compound 9 and rimsulfuron; compound 15 and rimsulfuron; compound 16 and rimsulfuron; compound 4 and rimsulfuron; compound 17 and sulfometuron-methyl; compound 2 and sulfometuron-methyl; compound 4 and sulfometuron-methyl; compound 5 and sulfometuron-methyl; compound 9 and sulfometuron-methyl; compound 15 and sulfometuron-methyl; compound 16 and sulfometuron-methyl; compound 17 and sulfometuron-methyl; compound 1 and terbacil; compound 2 and terbacil; compound 4 and terbacil; compound 5 and terbacil; compound 9 and terbacil; compound 15 and terbacil; compound 16 and terbacil; compound 17 and terbacil.

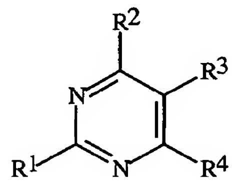
Compounds of this invention can also be used in combination with herbicide safeners such as benoxacor, BCS (1-bromo-4-[(chloromethyl)sulfonyl]benzene), cloquintocet-mexyl, cyometrinil, dichlormid, 2-(dichloromethyl)-2-methyl-1,3-dioxolane (MG 191), fenchlorazole-ethyl, fenclorim, flurazole, fluxofenim, furilazole, isoxadifen-ethyl, mefenpyr-ethyl, methoxyphenone ((4-methoxy-3-methylphenyl)(3-methylphenyl)methanone), naphthalic anhydride (1,8-naphthalic anhydride) and oxabetrinil to increase safety to certain crops. Antidotally effective amounts of the herbicide safeners can be applied at the same time as the compounds of this invention, or applied as seed treatments. Therefore an aspect of the present invention relates to a herbicidal mixture comprising a compound of this invention and an antidotally effective amount of a herbicide safener. Seed treatment is particularly useful for selective weed control, because it physically restricts antidoting to the crop plants. Therefore a particularly useful embodiment of the present invention is a method for selectively controlling the growth of undesired vegetation in a crop comprising contacting the locus of the crop with a herbicidally effective amount of a compound of this invention wherein seed from which the crop is grown is treated with an antidotally effective amount of safener. Antidotally effective amounts of safeners can be easily determined by one skilled in the art through simple experimentation.

Compounds of this invention can also be used in combination with plant growth regulators such as aviglycine, *N*-(phenylmethyl)-1*H*-purin-6-amine, epocholeone, gibberellic acid, gibberellin A_4 and A_7, harpin protein, mepiquat chloride, prohexadione calcium, prohydrojasmon, sodium nitrophenolate and trinexapac-methyl, and plant growth modifying organisms such as *Bacillus cereus* strain BP01.

The following Tests demonstrate the control efficacy of the compounds of this invention against specific weeds. The weed control afforded by the compounds is not limited, however, to these species. See Index Tables A–B for compound descriptions. The following abbreviations are used in the Index Tables which follow: *t* means tertiary, *s* means secondary, *n* means normal, *i* means iso, *c* means cyclo, Me means methyl, Et means ethyl, Pr means propyl, *i*-Pr means isopropyl, Bu means butyl, Ph means phenyl, MeO means methoxy, EtO means ethoxy, and CN means cyano. The abbreviation "dec." indicates that

the compound appeared to decompose on melting. The abbreviation "Ex." stands for "Example" and is followed by a number indicating in which example the compound is prepared.

INDEX TABLE A



Compound	R^1	R^2	R^3	R^4	m.p. (°C)
1 (Ex. 1)	*c*-Pr	$CO_2CH_2CH_3$	Br	NH_2	107–108
2 (Ex. 1)	*c*-Pr	CO_2CH_3	Br	NH_2	148–150
3	*i*-Pr	CO_2CH_3	Br	NH_2	107–109
4	*c*-Pr	$CO_2CH_2CH_3$	Cl	NH_2	87–89
5	*c*-Pr	CO_2CH_3	Br	$NHCH_3$	*
6	Cl	CO_2CH_3	Cl	NH_2	169–171
7	*c*-Pr	CO_2CH_3	I	NH_2	145–146
8	*c*-Pr	CO_2H	Br	NH_2	160–162
9	*c*-Pr	CO_2CH_3	Cl	NH_2	143–145
10	*c*-Pr	CO_2CH_3	Br	$NHCH_2CO_2CH_3$	95–96
11	*c*-Pr	CH_2OCH_3	Br	NH_2	*
12	*c*-Pr	$CH_2CO_2CH_2CH_3$	Br	NH_2	*
13	*c*-Pr	$CH_2CO_2CH_3$	Br	NH_2	*
14	*c*-Pr	$CO_2(i\text{-Pr})$	Br	NH_2	141–142
15	*c*-Pr	$CO_2CH_2CH_2CH_3$	Br	NH_2	86–90
16	*c*-Pr	$CO_2CH_2CH_2CH_2CH_3$	Br	NH_2	87–90
17	*c*-Pr	$CO_2(i\text{-Bu})$	Br	NH_2	121–123
18	Ph	$CO_2CH_2CH_3$	Br	NH_2	110–111
19	*c*-Pr	CO_2CH_3	Br	$N{=}CHN(CH_3)_2$	*
20	*c*-Pr	$C(O)NH_2$	Br	NH_2	*
21	*c*-Pr	CH_2OH	Br	NH_2	182–185
22	*c*-Pr	CO_2CH_2Ph	Br	NH_2	129–131
23	Ph	CO_2CH_3	Br	NH_2	*
24	*c*-Pr	CHO	F	NH_2	*
25	*c*-Pr	CO_2CH_3	F	NH_2	*
26	*c*-Pr	CHO	Br	NH_2	*
27	*c*-Pr	CH(=NOH)	Br	NH_2	*

Compound	R^1	R^2	R^3	R^4	m.p. (°C)
28	2-Me-*c*-Pr	CO_2CH_3	Br	NH_2	132–133
29	SCH_3	$CO_2CH_2CH_3$	Cl	NH_2	*
30	*c*-Pr	$CO_2CH_2CH_3$	F	NH_2	*
31	*c*-Pr	$CH(Cl)CO_2CH_2CH_3$	Br	NH_2	*
32	*c*-Pr	$CH(CH_3)CO_2CH_2CH_3$	Br	NH_2	*
33	*c*-Pr	$CH_2CO_2CH_2CH_3$	Br	$N{=}CHN(CH_3)_2$	*
34	*c*-Pr	$CCl_2CO_2CH_2CH_3$	Br	NH_2	*
35	*c*-Pr	CO_2CH_3	Br	NHOH	*
36	*t*-Bu	$CO_2CH_2CH_3$	Br	NH_2	69–70
37	4-Cl-Ph	$CO_2CH_2CH_3$	Br	NH_2	120–121
38	*c*-Pr	$CO_2CH_2CH_3$	Br	$NHCH_2CH_2N(CH_3)_2$	*
39	*c*-Pr	$CO_2CH_2CH_3$	Br	$NHCH_2CH_2OCH_3$	*
40	*c*-Pr	$CO_2CH_2CH_3$	Br	$N{=}CHN(CH_3)_2$	*
41	4-Cl-Ph	$CH_2CO_2CH_2CH_3$	Br	NH_2	*
42	*c*-Pr	$CO_2CH_2CH_3$	Br	$NHNH_2$	*
43	4-F-Ph	CO_2CH_3	Cl	NH_2	*
44	4-CF_3-Ph	CO_2CH_3	Cl	NH_2	*

* See Index Table B for ^1H NMR data.

INDEX TABLE B

Compound	^1H NMR Data ($CDCl_3$ solution unless indicated otherwise)[a]
5	δ 5.60 (br s, 1H), 3.96 (s, 3H), 3.02 (d, 3H), 2.10 (m, 1H), 1.25 (t, 3H), 1.10 (m, 2H), 0.98 (m, 2H).
11	δ 5.20 (br s, 2H), 4.97 (s, 2H), 3.49 (s, 3H), 2.07 (m, 1H), 1.25 (t, 3H), 1.02 (m, 2H), 0.95 (m, 2H).
12	δ 5.20 (br s, 2H), 4.18 (q, 2H), 3.80 (s, 2H), 1.90 (m, 1H), 1.25 (t, 3H), 1.01–0.93 (m, 4H).
13	δ 5.26 (br s, 2H), 3.82 (s, 2H), 3.73 (s, 3H), 1.90 (m, 1H), 1.02–0.92 (m, 4H).
19	δ 8.60 (s, 1H), 3.97 (s, 3H), 3.20 (s, 3H), 3.19 (s, 3H), 2.10 (m, 1H), 1.08 (m, 2H), 0.99 (m, 2H).
20	δ 7.65 (br s, 1H), 5.94 (br s, 2H), 5.8 (br s, 1H), 2.01 (m, 1H), 1.03 (m, 4H).
23	δ 8.35 (m, 2H), 7.46 (m, 3H), 5.61 (br s, 2H), 4.02 (s, 3H).
24	δ 10.01 (s, 1H), 5.31 (br s, 2H), 2.10 (m, 1H), 1.10–0.95 (m, 4H).
25	δ 5.15 (br s, 2H), 3.98 (s, 3H), 2.03 (m, 1H), 1.04–0.92 (m, 4H).
26	δ 9.98 (s, 1H), 5.60 (br s, 2H), 2.10 (m, 1H), 1.10–1.02 (m, 4H).
27	δ 8.19 (s, 1H), 1.89 (m, 1H), 0.92-0.87 (m, 4H).
29	δ 5.55 (br s, 2H), 4.45 (q, 2H), 2.51 (s, 3H), 1.42 (t, 3H).
30	δ 5.12 (br s, 2H), 4.45 (q, 2H), 2.13 (m, 1H), 1.41 (t, 3H), 1.04–0.92 (m, 4H).

Compound	^1H NMR Data ($CDCl_3$ solution unless indicated otherwise)[a]
31	δ 5.66 (s, 1H), 5.34 (br s, 2H), 4.30 (q, 2H), 1.98 (m, 1H), 1.30 (t, 3H), 1.13–0.92 (m, 4H).
32	δ 5.26 (br s, 2H), 4.21–4.07 (m, 3H), 1.94 (m, 1H), 1.45 (d, 2H), 1.22 (t, 3H), 1.08–0.90 (m, 4H).
33	δ 8.57 (s, 1H), 4.18 (q, 2H), 3.88 (s, 2H), 3.18 (s, 3H), 3.16 (s, 3H), 2.00 (m, 1H), 1.24 (t, 3H), 1.05–0.96 (m, 4H).
34	δ 5.48 (br s, 2H), 4.38 (q, 2H), 2.02 (m, 1H), 1.36 (t, 3H), 1.11–0.97(m, 4H).
35	δ 3.97 (s, 3H), 2.07 (m, 1H), 1.20–1.13 (m, 2H), 1.12–1.04 (m, 2H)
38	δ 6.20 (br s, 1H), 4.43 (q, 2H), 3.48 (m, 2H), 2.50 (m, 2H), 2.27 (s, 6H), 2.07 (m, 1H), 1.41 (t, 3H), 1.07 (m, 2H), 0.96 (m, 2H).
39	δ 5.90 (br s, 1H), 4.43 (q, 2H), 3.65 (m, 2H), 3.54 (m, 2H), 3.39 (s, 3H), 2.08 (m, 1H), 1.41 (t, 3H), 1.04 (m, 2H), 0.98 (m, 2H).
40	δ 8.59 (s, 1H), 4.44 (q, 2H), 3.20 (s, 3H), 3.18 (s, 3H), 2.10 (m, 1H), 1.41 (t, 3H), 1.11–1.05 (m, 2H), 1.01-0.94 (m, 2H).
41	δ 8.27 (m, 2H), 7.39 (m, 2H), 5.39 (br s, 2H), 4.23 (q, 2H), 3.93 (s, 2H), 1.29 (t, 3H).
42	δ 6.70 (br s, 1H), 4.43 (q, 2H), 4.0 (br s, 2H), 2.10 (m, 1H), 1.41 (t, 3H), 1.11 (m, 2H), 1.01 (m, 2H).
43	δ 8.35 (m, 2H), 7.10 (dd, 2H), 5.54 (br s, 2H), 4.02 (s, 3H).
44	δ 8.47 (d, 2H), 7.69 (d, 2H), 5.61 (br s, 2H), 4.04 (s, 3H).

[a] ^1H NMR data are in ppm downfield from tetramethylsilane. Couplings are designated by (s)-singlet, (d)-doublet, (t)-triplet, (q)-quartet, (m)-multiplet, (dd)-doublet of doublets, (dt)-doublet of triplets, (dq)-doublet of quartets, (br s)-broad singlet, (br d)-broad d, (br m)-broad multiplet.

BIOLOGICAL EXAMPLES OF THE INVENTION

TEST A

Seeds of barnyardgrass (*Echinochloa crus-galli*), crabgrass (*Digitaria sanguinalis*), giant foxtail (*Setaria faberi*), morningglory (*Ipomoea* spp.), redroot pigweed (*Amaranthus retroflexus*) and velvetleaf (*Abutilon theophrasti*) were planted into a blend of loam soil and sand and treated preemergence with a directed soil spray using test chemicals formulated in a non-phytotoxic solvent mixture which included a surfactant. At the same time these species were also treated with postemergence applications of test chemicals formulated in the same manner.

Plants ranged in height from 2 to 10 cm and were in the 1- to 2-leaf stage for the postemergence treatment. Treated plants and untreated controls were maintained in a greenhouse for approximately ten days, after which time all treated plants were compared to untreated controls and visually evaluated for injury. Plant response ratings, summarized in Table A, are based on a 0 to 100 scale where 0 is no effect and 100 is complete control. A dash (–) response means no test results.

Table A	Compounds	
2000 g ai/ha	1	29
Postemergence		
Barnyardgrass	75	30
Crabgrass	80	0
Foxtail, Giant	75	50
Morningglory	100	35
Pigweed	100	30
Velvetleaf	85	20

Table A	Compounds		
500 g ai/ha	1	20	29
Postemergence			
Barnyardgrass	75	0	0
Crabgrass	65	0	0
Foxtail, Giant	70	0	20
Morningglory	95	40	20
Pigweed	100	60	0
Velvetleaf	95	55	20

Table A	Compound
125 g ai/ha	20
Postemergence	
Barnyardgrass	0
Crabgrass	0
Foxtail, Giant	0
Morningglory	20
Pigweed	40
Velvetleaf	10

Table A	Compound
1000 g ai/ha	43
Preemergence	
Barnyardgrass	10
Crabgrass	10
Foxtail, Giant	10
Morningglory	45
Pigweed	75
Velvetleaf	20

Table A	Compound
1000 g ai/ha	43
Postemergence	
Barnyardgrass	20
Crabgrass	30
Foxtail, Giant	10
Morningglory	45
Pigweed	85
Velvetleaf	50

Table A	Compound
250 g ai/ha	43
Postemergence	
Barnyardgrass	10
Crabgrass	10
Foxtail, Giant	10
Morningglory	20
Pigweed	60
Velvetleaf	50

Table A	Compounds	
2000 g ai/ha	1	29
Preemergence		
Barnyardgrass	80	0
Crabgrass	75	25
Foxtail, Giant	85	30
Morningglory	100	0
Pigweed	100	85
Velvetleaf	80	0

Table A	Compounds		
500 g ai/ha	1	20	29
Preemergence			
Barnyardgrass	60	0	0
Crabgrass	25	0	0
Foxtail, Giant	40	0	0
Morningglory	85	60	0
Pigweed	85	70	15
Velvetleaf	60	70	0

Table A	Compound
250 g ai/ha	43
Preemergence	
Barnyardgrass	0
Crabgrass	0
Foxtail, Giant	0
Morningglory	0
Pigweed	0
Velvetleaf	0

Table A	Compound
125 g ai/ha	20
Preemergence	
Barnyardgrass	0
Crabgrass	0
Foxtail, Giant	0
Morningglory	10
Pigweed	40
Velvetleaf	0

TEST B

Seeds selected from barnyardgrass (*Echinochloa crus-galli*), Surinam grass (*Brachiaria decumbens*), cocklebur (*Xanthium strumarium*), corn (*Zea mays*), crabgrass (*Digitaria sanguinalis*), giant foxtail (*Setaria faberii*), lambsquarters (*Chenopodium album*), morningglory (*Ipomoea hederacea*), pigweed (*Amaranthus retroflexus*), rice (*Oryza sativa*), velvetleaf (*Abutilon theophrasti*), and wheat (*Triticum aestivum*) were planted and treated preemergence with test chemicals formulated in a non-phytotoxic solvent mixture which included a surfactant.

At the same time, plants selected from these crop and weed species and also blackgrass (*Alopecurus myosuroides*) and wild oat (*Avena fatua*) were treated with postemergence applications of test chemicals formulated in the same manner. Plants ranged in height from 2 to 18 cm (1- to 4-leaf stage) for postemergence treatments. Plant species in the flooded paddy test consisted of rice (*Oryza sativa*), umbrella sedge (*Cyperus difformis*), duck salad (*Heteranthera limosa*) and barnyardgrass (*Echinochloa crus-galli*) grown to the 2-leaf stage for testing. Treated plants and controls were maintained in a greenhouse for 13 to 15 days, after which time all species were compared to controls and visually evaluated. Plant response ratings, summarized in Table B, are based on a scale of 0 to 100 where 0 is no effect and 100 is complete control. A dash (–) response means no test result.

Table B	Compounds													
1000 g ai/ha	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Flood														
Barnyardgrass	80	90	0	90	50	0	20	70	90	0	0	0	0	80
Ducksalad	80	90	0	100	90	70	0	90	100	0	70	20	0	80
Rice	70	60	0	80	0	0	0	60	80	0	0	20	0	20
Sedge, Umbrella	20	90	0	80	90	50	0	40	90	0	20	0	0	50

Table B	Compounds													
1000 g ai/ha	15	16	17	18	19	21	22	23	24	25	26	27	28	29
Flood														
Barnyardgrass	90	90	80	0	80	60	80	0	0	30	60	0	0	0
Ducksalad	80	90	90	80	80	80	90	30	0	40	90	60	30	0
Rice	70	70	50	0	60	40	60	0	10	30	70	20	0	0
Sedge, Umbrella	70	60	50	0	70	0	50	0	20	40	80	60	0	0

Table B	Compounds									
1000 g ai/ha	30	31	32	33	34	35	36	37	38	39
Flood										
Barnyardgrass	0	30	0	0	0	0	0	20	0	0
Ducksalad	0	60	0	0	0	0	0	100	0	0
Rice	0	20	0	0	0	0	0	0	0	0
Sedge, Umbrella	0	0	0	0	0	0	0	90	0	0

Table B	Compounds													
500 g ai/ha	2	3	5	6	7	8	9	10	11	12	13	14	15	16
Postemergence														
Barnyardgrass	90	10	90	0	30	90	90	10	90	40	10	90	90	90
Blackgrass	80	50	80	30	80	0	80	0	60	0	20	60	80	70
Cocklebur	100	100	100	90	100	100	100	70	90	70	40	70	100	100
Corn	80	0	90	0	30	90	90	0	0	0	0	70	80	80
Crabgrass	90	40	90	0	30	90	90	40	70	30	30	30	60	80
Foxtail, Giant	80	40	50	0	40	90	90	10	50	30	20	50	70	80
Lambsquarters	100	100	100	70	100	100	100	90	100	80	70	100	100	100
Morningglory	100	100	100	90	90	100	100	80	100	80	70	100	100	100
Oat, Wild	70	30	60	10	70	0	70	10	10	0	0	70	70	60
Pigweed	100	90	100	90	90	100	100	90	90	80	70	90	100	100
Surinam Grass	90	30	80	0	20	90	90	10	50	0	0	50	90	90
Velvetleaf	100	80	90	90	90	100	100	80	80	60	50	70	90	90
Wheat	70	20	60	20	80	0	70	0	40	0	0	50	70	60

Table B	Compounds													
500 g ai/ha	17	18	19	21	22	23	24	25	26	27	28	29	30	31
Postemergence														
Barnyardgrass	90	0	90	0	90	0	10	80	60	0	50	10	80	0
Blackgrass	70	0	80	20	80	10	10	60	70	30	30	0	70	0
Cocklebur	100	70	100	10	100	90	70	90	90	100	100	0	100	80
Corn	80	0	70	0	80	0	10	30	20	20	0	0	30	0

Crabgrass	50	0	80	0	90	0	40	80	70	10	50	0	90	30
Foxtail, Giant	70	0	80	0	80	10	30	80	40	30	40	0	90	0
Lambsquarters	100	90	100	20	100	80	80	90	80	90	90	70	100	70
Morningglory	100	70	100	30	100	70	90	90	80	90	90	70	100	70
Oat, Wild	50	0	70	0	60	10	0	20	40	30	10	0	70	0
Pigweed	90	70	100	30	100	70	80	100	80	70	90	30	100	50
Surinam Grass	80	0	90	0	90	10	10	70	60	0	50	0	80	0
Velvetleaf	100	50	100	30	100	70	50	70	70	70	90	50	90	60
Wheat	60	0	60	20	70	20	0	30	30	30	10	0	60	0

Table B						Compounds						
500 g ai/ha	32	33	34	35	36	37	38	39	40	41	42	44
Postemergence												
Barnyardgrass	70	20	60	90	0	90	0	70	90	70	30	50
Blackgrass	40	40	70	70	40	60	0	0	60	60	60	40
Cocklebur	90	80	80	100	70	100	0	50	90	-	90	100
Corn	10	0	0	60	0	70	0	50	60	80	0	70
Crabgrass	20	20	30	50	0	80	20	40	80	20	30	80
Foxtail, Giant	20	40	50	60	10	60	0	30	60	30	0	-
Lambsquarters	80	70	90	100	50	100	60	90	100	90	90	90
Morningglory	90	70	70	100	70	100	40	100	100	90	90	100
Oat, Wild	30	20	40	60	40	0	0	0	60	0	0	0
Pigweed	80	80	80	100	30	100	30	70	100	90	90	90
Surinam Grass	10	0	50	80	0	70	20	30	70	10	10	50
Velvetleaf	50	50	60	90	40	100	50	70	90	70	80	90
Wheat	30	20	40	60	40	60	0	0	60	40	50	30

Table B	Compounds	
250 g ai/ha	1	4
Postemergence		
Barnyardgrass	90	90
Blackgrass	70	90
Cocklebur	90	100
Corn	70	90
Crabgrass	90	90
Foxtail, Giant	80	90
Lambsquarters	100	100
Morningglory	100	100
Oat, Wild	60	80

Pigweed	100	100
Surinam Grass	90	90
Velvetleaf	90	100
Wheat	70	80

Table B	Compounds													
125 g ai/ha	2	3	5	6	7	8	9	10	11	12	13	14	15	16
Postemergence														
Barnyardgrass	90	0	50	0	0	90	90	0	20	0	0	30	90	70
Blackgrass	50	20	70	10	60	0	60	0	20	0	10	30	70	10
Cocklebur	100	70	80	40	90	100	100	60	80	40	10	50	100	90
Corn	20	0	30	0	0	70	70	0	0	0	0	30	50	30
Crabgrass	90	30	50	0	10	80	90	30	30	10	20	10	30	30
Foxtail, Giant	70	20	40	0	20	80	90	0	10	0	10	20	40	30
Lambsquarters	100	100	100	30	80	100	90	80	90	60	60	100	100	100
Morningglory	100	80	100	0	80	100	100	80	80	60	50	100	100	100
Oat, Wild	40	10	40	0	40	0	20	0	0	0	0	20	10	10
Pigweed	100	80	90	20	0	100	100	80	80	50	50	80	80	90
Surinam Grass	90	10	50	0	0	80	90	10	20	0	0	10	60	60
Velvetleaf	60	50	70	20	50	80	100	50	60	20	40	50	80	80
Wheat	40	10	50	10	50	0	40	0	0	0	0	20	40	30

Table B	Compounds													
125 g ai/ha	17	18	19	21	22	23	24	25	26	27	28	29	30	32
Postemergence														
Barnyardgrass	20	0	80	0	70	0	0	40	20	0	20	0	0	20
Blackgrass	0	0	60	10	60	0	0	10	40	30	10	0	60	30
Cocklebur	100	70	90	0	100	30	50	90	80	100	90	0	100	40
Corn	0	0	30	0	20	0	0	0	0	0	0	0	0	0
Crabgrass	20	0	40	0	50	0	20	60	40	10	30	0	30	10
Foxtail, Giant	10	0	20	0	70	0	20	50	30	20	20	0	0	10
Lambsquarters	100	70	100	10	100	70	70	90	70	80	90	30	90	70
Morningglory	100	20	100	10	90	40	60	90	70	70	90	20	90	40
Oat, Wild	0	0	40	0	10	10	0	10	30	20	0	0	60	20
Pigweed	70	20	90	0	100	30	70	90	70	60	80	0	90	80
Surinam Grass	30	0	40	0	80	0	0	50	30	0	10	0	10	0
Velvetleaf	60	20	70	10	100	40	40	60	40	60	70	10	50	10
Wheat	0	0	20	10	0	0	0	20	30	20	0	0	50	20

Table B	Compounds										
125 g ai/ha	33	34	35	36	37	38	39	40	41	42	44
Postemergence											
Barnyardgrass	0	0	40	0	0	0	0	0	20	10	40
Blackgrass	40	60	60	0	40	0	0	50	20	30	30
Cocklebur	60	80	30	20	100	0	30	0	70	80	90
Corn	0	0	0	0	0	0	0	0	20	0	30
Crabgrass	10	0	20	0	60	0	0	0	10	0	70
Foxtail, Giant	10	20	10	0	10	0	0	0	20	0	-
Lambsquarters	60	70	90	40	100	20	70	0	80	80	90
Morningglory	40	60	70	10	90	10	80	0	70	80	80
Oat, Wild	20	30	60	0	0	0	0	40	0	0	0
Pigweed	60	50	70	20	100	30	50	0	70	80	80
Surinam Grass	0	10	20	0	20	0	0	0	0	0	-
Velvetleaf	40	30	50	20	80	0	40	0	50	50	80
Wheat	20	30	20	0	0	0	0	50	30	50	0

Table B	Compounds		
62 g ai/ha	1	4	31
Postemergence			
Barnyardgrass	50	70	0
Blackgrass	40	70	0
Cocklebur	90	90	70
Corn	30	50	0
Crabgrass	70	80	0
Foxtail, Giant	50	80	0
Lambsquarters	100	100	40
Morningglory	90	90	50
Oat, Wild	20	50	0
Pigweed	90	100	20
Surinam Grass	60	90	0
Velvetleaf	90	70	10
Wheat	30	40	0

Table B	Compounds													
500 g ai/ha	2	3	5	6	7	8	9	10	11	12	13	14	15	16
Preemergence														
Barnyardgrass	90	0	30	0	30	90	90	50	10	80	80	80	90	90
Cocklebur	100	80	80	60	80	100	100	90	90	90	100	80	100	100

Corn	80	0	70	0	0	90	80	0	0	30	30	70	80	70
Crabgrass	90	50	70	0	30	90	100	60	80	70	70	80	90	100
Foxtail, Giant	90	0	10	0	0	90	80	20	70	50	40	80	80	80
Lambsquarters	100	90	100	0	90	100	100	90	100	100	100	100	100	100
Morningglory	100	60	80	0	80	100	100	90	90	90	100	100	100	100
Pigweed	100	90	90	0	90	100	100	90	90	90	90	90	100	90
Surinam Grass	90	20	10	10	0	90	90	0	70	-	-	80	90	80
Velvetleaf	100	70	90	30	80	100	100	90	90	90	90	80	100	100
Wheat	70	0	50	0	30	80	80	0	50	60	60	50	60	60

Table B	Compounds													
500 g ai/ha	17	18	19	21	22	23	24	25	26	27	28	29	30	31
Preemergence														
Barnyardgrass	80	0	90	10	20	0	20	60	90	60	30	0	40	70
Cocklebur	90	40	100	80	80	10	90	90	90	90	90	0	100	100
Corn	60	0	90	-	-	0	0	0	80	50	0	0	80	40
Crabgrass	100	0	90	60	100	0	80	70	90	70	80	0	90	80
Foxtail, Giant	70	0	80	10	20	0	60	80	80	40	50	0	80	80
Lambsquarters	100	60	100	80	100	30	90	90	100	100	100	0	90	100
Morningglory	100	0	100	90	100	10	90	90	100	90	90	0	100	100
Pigweed	100	70	100	70	80	20	90	90	100	100	90	0	90	100
Surinam Grass	90	0	90	20	20	0	50	70	80	70	60	0	80	60
Velvetleaf	90	40	100	80	100	20	80	80	100	90	90	0	80	90
Wheat	60	0	60	30	50	0	70	60	60	50	40	0	60	70

Table B	Compounds											
500 g ai/ha	32	33	34	35	36	37	38	39	40	41	42	44
Preemergence												
Barnyardgrass	10	50	0	80	0	40	0	20	90	10	0	10
Cocklebur	90	90	60	90	60	80	0	30	100	10	70	80
Corn	0	30	0	50	0	10	10	50	50	0	0	0
Crabgrass	40	50	70	80	0	90	0	50	80	20	20	80
Foxtail, Giant	0	40	20	70	0	60	0	20	80	0	0	40
Lambsquarters	90	100	80	100	40	100	90	100	100	60	90	60
Morningglory	80	90	70	100	0	50	50	70	100	20	80	40
Pigweed	90	90	80	100	20	100	70	100	100	60	90	80
Surinam Grass	0	40	50	60	0	40	0	0	70	0	20	60
Velvetleaf	80	80	60	90	40	80	0	30	90	30	70	80
Wheat	10	50	10	50	0	60	0	10	70	20	10	60

Table B	Compounds	
250 g ai/ha	1	4
Preemergence		
Barnyardgrass	90	90
Cocklebur	100	100
Corn	80	80
Crabgrass	90	90
Foxtail, Giant	90	80
Lambsquarters	100	100
Morningglory	100	100
Pigweed	100	100
Surinam Grass	80	90
Velvetleaf	100	90
Wheat	60	70

Table B							Compounds							
125 g ai/ha	2	3	5	6	7	8	9	10	11	12	13	14	15	16
Preemergence														
Barnyardgrass	70	0	10	0	0	70	50	20	0	50	40	10	40	30
Cocklebur	90	80	70	10	70	90	90	80	80	80	90	60	70	70
Corn	0	0	0	0	0	90	50	0	0	0	-	0	20	30
Crabgrass	90	10	20	0	0	80	90	20	30	20	50	10	70	70
Foxtail, Giant	30	0	0	0	0	50	70	0	10	20	20	30	40	30
Lambsquarters	100	70	90	0	80	90	90	-	100	90	90	90	90	100
Morningglory	100	50	70	0	70	100	100	80	80	70	90	70	70	90
Pigweed	90	80	90	0	90	100	90	80	80	80	80	80	90	90
Surinam Grass	40	0	0	10	0	60	70	0	10	0	0	40	30	40
Velvetleaf	90	40	70	0	50	80	90	80	80	80	80	60	70	80
Wheat	60	0	-	0	0	60	40	0	0	30	40	40	40	50

Table B							Compounds							
125 g ai/ha	17	18	19	21	22	23	24	25	26	27	28	29	30	32
Preemergence														
Barnyardgrass	20	0	40	0	0	0	0	20	50	30	10	0	10	0
Cocklebur	80	10	90	30	50	0	80	80	80	80	80	0	60	80
Corn	0	0	70	0	10	0	-	0	30	10	0	0	10	0
Crabgrass	70	0	80	0	20	0	60	60	30	30	70	0	50	0
Foxtail, Giant	20	0	20	0	0	0	10	40	10	0	30	0	10	0
Lambsquarters	90	10	100	70	70	0	70	90	100	90	80	0	80	40

Morningglory	100	0	90	50	100	0	50	80	90	80	80	0	90	40
Pigweed	80	0	90	50	60	0	80	80	90	90	80	0	50	40
Surinam Grass	30	0	60	0	0	0	10	20	10	0	-	0	0	0
Velvetleaf	70	0	90	10	30	0	50	70	90	80	80	0	10	50
Wheat	40	0	50	0	10	0	30	50	30	10	10	0	30	0

Table B	Compounds										
125 g ai/ha	33	34	35	36	37	38	39	40	41	42	44
Preemergence											
Barnyardgrass	20	0	10	0	10	0	0	50	0	0	0
Cocklebur	80	30	60	10	20	0	10	90	0	40	10
Corn	10	0	0	0	0	0	30	0	0	0	0
Crabgrass	0	0	30	0	50	0	0	60	0	0	40
Foxtail, Giant	0	0	0	0	10	0	0	20	0	0	20
Lambsquarters	90	50	90	0	100	20	50	100	30	40	-
Morningglory	0	20	70	0	10	0	30	90	0	20	10
Pigweed	80	40	80	0	100	10	70	90	0	50	70
Surinam Grass	0	10	10	0	-	0	0	50	-	0	40
Velvetleaf	70	30	70	10	40	0	0	90	10	10	30
Wheat	0	0	20	0	30	0	0	40	0	10	30

Table B	Compounds		
62 g ai/ha	1	4	31
Preemergence			
Barnyardgrass	60	30	20
Cocklebur	90	80	90
Corn	20	0	0
Crabgrass	90	70	10
Foxtail, Giant	30	10	10
Lambsquarters	100	90	90
Morningglory	90	60	90
Pigweed	90	90	90
Surinam Grass	50	40	20
Velvetleaf	90	80	80
Wheat	30	50	40

TEST C

Seeds of plant species selected from bermudagrass (*Cynodon dactylon*), Surinam grass (*Brachiaria decumbens*), cocklebur (*Xanthium strumarium*), corn (*Zea mays*), crabgrass (*Digitaria sanguinalis*), woolly cupgrass (*Eriochloa villosa*), giant foxtail (*Setaria faberii*),

goosegrass (*Eleusine indica*), johnsongrass (*Sorghum halepense*), kochia (*Kochia scoparia*), lambsquarters (*Chenopodium album*), morningglory (*Ipomoea hederacea*), eastern black nightshade (*Solanum ptycanthum*), yellow nutsedge (*Cyperus esculentus*), pigweed (*Amaranthus retroflexus*), common ragweed (*Ambrosia elatior*), soybean (*Glycine max*), common (oilseed) sunflower (*Helianthus annuus*), and velvetleaf (*Abutilon theophrasti*) were planted and treated preemergence with test chemicals formulated in a non-phytotoxic solvent mixture which included a surfactant.

At the same time, plants selected from these crop and weed species and also winter barley (*Hordeum vulgare*), blackgrass (*Alopecurus myosuroides*), canarygrass (*Phalaris minor*), chickweed (*Stellaria media*), downy brome (*Bromus tectorum*), green foxtail (*Setaria viridis*), Italian ryegrass (*Lolium multiflorum*), wheat (*Triticum aestivum*), wild oat (*Avena fatua*) and windgrass (*Apera spica-venti*) were treated with postemergence applications of some of the test chemicals formulated in the same manner. Plants ranged in height from 2 to 18 cm (1- to 4-leaf stage) for postemergence treatments. Plant species in the flooded paddy test consisted of rice (*Oryza sativa*), umbrella sedge (*Cyperus difformis*), duck salad (*Heteranthera limosa*) and barnyardgrass (*Echinochloa crus-galli*) grown to the 2-leaf stage for testing. Treated plants and controls were maintained in a greenhouse for 12 to 14 days, after which time all species were compared to controls and visually evaluated. Plant response ratings, summarized in Table C, are based on a scale of 0 to 100 where 0 is no effect and 100 is complete control. A dash (–) response means no test result.

Table C					Compounds						
500 g ai/ha	1	2	4	5	9	14	15	16	17	19	22
Flood											
Barnyardgrass	25	75	85	20	85	45	75	50	50	60	70
Ducksalad	0	95	100	0	90	55	85	85	80	60	95
Rice	0	65	80	0	75	0	50	65	75	20	60
Sedge, Umbrella	0	25	75	0	85	30	25	55	25	50	95

Table C					Compounds						
250 g ai/ha	1	2	4	5	9	14	15	16	17	19	22
Flood											
Barnyardgrass	15	45	65	0	55	0	25	15	0	0	40
Ducksalad	0	90	90	0	80	45	50	75	80	60	90
Rice	0	45	75	0	55	0	20	0	45	10	40
Sedge, Umbrella	0	0	65	0	15	0	10	50	20	50	75

Table C	Compounds										
125 g ai/ha	1	2	4	5	9	14	15	16	17	19	22
Flood											
Barnyardgrass	0	20	60	0	15	0	0	0	0	0	0
Ducksalad	-	70	80	0	70	40	45	65	0	40	60
Rice	0	25	40	0	30	0	0	0	0	0	20
Sedge, Umbrella	-	0	30	0	15	0	0	0	0	50	30

Table C	Compounds										
62 g ai/ha	1	2	4	5	9	14	15	16	17	19	22
Flood											
Barnyardgrass	0	0	0	0	0	0	0	0	0	0	0
Ducksalad	0	50	70	0	45	0	45	65	0	20	30
Rice	0	0	0	0	0	0	0	0	0	0	20
Sedge, Umbrella	0	0	0	0	0	0	0	-	0	20	0

Table C	Compounds						
500 g ai/ha	1	4	5	7	8	10	15
Postemergence							
Barley	-	65	-	-	-	-	-
Bermudagrass	90	80	80	0	75	0	75
Blackgrass	-	70	-	-	-	-	-
Brome, Downy	-	70	-	-	-	-	-
Canarygrass	-	60	-	-	-	-	-
Chickweed	-	100	-	0	100	70	85
Cocklebur	100	100	100	30	100	75	100
Corn	45	95	45	0	90	0	75
Crabgrass	90	80	80	25	75	0	80
Cupgrass, Woolly	90	95	70	20	85	0	75
Foxtail, Giant	90	95	60	10	75	0	70
Foxtail, Green	-	75	-	-	-	-	-
Goosegrass	70	75	50	0	60	0	55
Johnsongrass	70	95	45	0	85	0	80
Kochia	100	100	100	80	100	100	100
Lambsquarters	100	100	100	80	100	100	100
Morningglory	100	100	100	65	100	95	100
Nutsedge, Yellow	5	0	0	0	0	0	0
Oat, Wild	-	70	-	-	-	-	-
Pigweed	100	100	100	55	100	95	100

Ragweed	100	100	100	75	100	90	95
Ryegrass, Italian	-	65	-	-	-	-	-
Soybean	100	100	100	60	100	100	100
Surinam Grass	95	95	70	0	80	0	65
Velvetleaf	100	100	95	40	95	90	90
Wheat	-	65	-	-	-	-	-
Windgrass	-	75	-	-	-	-	-

Table C						Compounds						
250 g ai/ha	1	2	3	4	5	7	8	9	10	15	16	17
Postemergence												
Barley	-	60	30	65	-	-	-	-	-	-	-	-
Bermudagrass	90	80	45	70	70	0	65	80	0	65	75	0
Blackgrass	-	75	0	70	-	-	-	-	-	-	-	-
Brome, Downy	-	60	20	65	-	-	-	-	-	-	-	-
Canarygrass	-	40	10	60	-	-	-	-	-	-	-	-
Chickweed	90	95	40	100	20	0	95	100	20	65	35	85
Cocklebur	100	85	90	100	100	30	100	100	60	100	100	100
Corn	40	30	0	90	40	0	70	95	0	55	55	20
Crabgrass	85	70	0	75	70	5	70	80	0	65	75	65
Cupgrass, Woolly	90	75	0	85	50	0	75	85	0	65	65	20
Foxtail, Giant	80	70	0	85	50	0	70	80	0	65	65	35
Foxtail, Green	-	70	35	70	-	-	-	-	-	-	-	-
Goosegrass	40	45	0	65	40	0	45	45	0	40	20	0
Johnsongrass	70	60	0	95	45	0	45	85	0	70	70	60
Kochia	100	100	100	100	100	70	100	100	95	100	100	100
Lambsquarters	100	100	100	100	100	70	100	100	90	100	100	100
Morningglory	100	100	75	100	100	55	100	100	95	100	100	100
Nutsedge, Yellow	5	20	0	0	0	0	0	0	0	0	0	0
Oat, Wild	-	60	40	70	-	-	-	-	-	-	-	-
Pigweed	100	100	80	100	90	40	100	100	95	85	95	95
Ragweed	100	95	95	100	95	65	95	100	80	90	95	95
Ryegrass, Italian	-	60	35	65	-	-	-	-	-	-	-	-
Soybean	100	100	95	100	100	35	100	100	90	95	100	100
Surinam Grass	90	70	0	75	30	0	70	80	0	55	55	0
Velvetleaf	100	100	70	100	90	35	85	95	80	85	90	95
Wheat	-	65	10	65	-	-	-	-	-	-	-	-
Windgrass	-	70	30	70	-	-	-	-	-	-	-	-

Table C	Compounds													
125 g ai/ha	1	2	3	4	5	6	7	8	9	10	11	15	16	17
Postemergence														
Barley	-	60	0	65	-	-	-	-	-	-	-	-	-	-
Bermudagrass	90	70	0	65	50	0	0	60	70	0	0	45	60	0
Blackgrass	-	70	0	65	-	-	-	-	-	-	-	-	-	-
Brome, Downy	-	45	20	60	-	-	-	-	-	-	-	-	-	-
Canarygrass	-	40	10	45	-	-	-	-	-	-	-	-	-	-
Chickweed	-	75	0	85	10	0	0	75	100	0	0	50	20	55
Cocklebur	100	85	75	100	95	5	30	100	100	15	40	100	100	100
Corn	15	20	0	80	40	0	0	20	65	0	0	15	20	0
Crabgrass	85	60	0	75	50	5	0	65	75	0	20	45	45	20
Cupgrass, Woolly	80	70	0	70	50	0	0	60	70	0	0	50	0	0
Foxtail, Giant	65	65	0	75	30	0	0	60	75	0	0	60	55	0
Foxtail, Green	-	65	35	70	-	-	-	-	-	-	-	-	-	-
Goosegrass	0	0	0	20	5	0	0	0	40	0	0	0	0	0
Johnsongrass	30	25	0	80	40	0	0	35	80	0	0	55	60	40
Kochia	100	95	90	100	100	40	65	100	100	90	90	95	100	100
Lambsquarters	100	100	90	100	100	30	60	100	100	80	80	100	100	100
Morningglory	100	100	65	100	95	0	50	95	100	85	0	95	100	100
Nutsedge, Yellow	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oat, Wild	-	55	40	65	-	-	-	-	-	-	-	-	-	-
Pigweed	100	95	75	100	90	0	40	75	100	80	90	70	95	75
Ragweed	100	90	80	100	95	10	35	80	95	65	75	85	95	95
Ryegrass, Italian	-	60	35	60	-	-	-	-	-	-	-	-	-	-
Soybean	100	100	90	100	100	40	25	95	100	80	95	95	100	100
Surinam Grass	90	65	0	75	20	0	0	65	75	0	0	20	25	0
Velvetleaf	90	80	55	100	90	5	10	70	80	70	75	70	65	80
Wheat	-	65	0	60	-	-	-	-	-	-	-	-	-	-
Windgrass	-	70	30	65	-	-	-	-	-	-	-	-	-	-

Table C	Compound
125 g ai/ha	19
Postemergence	
Barley	45
Bermudagrass	45
Blackgrass	65
Brome, Downy	60
Canarygrass	65

Chickweed	5
Cocklebur	90
Corn	35
Crabgrass	70
Cupgrass, Woolly	65
Foxtail, Giant	55
Foxtail, Green	60
Goosegrass	0
Johnsongrass	-
Kochia	90
Lambsquarters	95
Morningglory	85
Nutsedge, Yellow	0
Oat, Wild	65
Pigweed	65
Ragweed	80
Ryegrass, Italian	70
Soybean	75
Surinam Grass	-
Velvetleaf	60
Wheat	45
Windgrass	60

Table C							Compounds							
62 g ai/ha	1	2	3	4	5	6	7	8	9	10	11	15	16	17
Postemergence														
Barley	-	35	0	30	-	-	-	-	-	-	-	-	-	-
Bermudagrass	70	60	0	40	5	0	0	50	65	0	0	0	0	0
Blackgrass	-	65	0	65	-	-	-	-	-	-	-	-	-	-
Brome, Downy	-	35	20	45	-	-	-	-	-	-	-	-	-	-
Canarygrass	-	40	10	35	-	-	-	-	-	-	-	-	-	-
Chickweed	80	65	0	30	0	0	0	20	85	0	0	20	0	0
Cocklebur	90	75	65	85	80	0	30	80	85	0	25	85	95	100
Corn	10	15	0	0	10	0	0	0	55	0	0	15	0	0
Crabgrass	30	55	0	70	40	0	0	60	70	0	0	15	15	0
Cupgrass, Woolly	65	60	0	60	5	0	0	30	60	0	0	0	0	0
Foxtail, Giant	40	35	0	60	20	0	0	40	65	0	0	45	20	0
Foxtail, Green	-	55	30	65	-	-	-	-	-	-	-	-	-	-
Goosegrass	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Johnsongrass	30	0	0	70	0	0	0	30	65	0	0	20	0	0
Kochia	100	95	65	100	100	5	40	95	100	80	75	95	100	100
Lambsquarters	100	100	90	100	95	5	50	75	95	60	70	100	100	100
Morningglory	100	75	60	15	95	0	-	95	95	70	0	90	95	95
Nutsedge, Yellow	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oat, Wild	-	55	30	60	-	-	-	-	-	-	-	-	-	-
Pigweed	90	80	65	100	85	0	20	70	70	65	80	65	90	65
Ragweed	100	85	75	100	90	0	25	60	80	45	65	75	85	85
Ryegrass, Italian	-	45	35	45	-	-	-	-	-	-	-	-	-	-
Soybean	100	100	75	100	95	40	25	95	100	70	80	95	95	95
Surinam Grass	90	55	0	60	0	0	0	40	65	0	0	0	0	0
Velvetleaf	85	70	55	80	55	0	0	60	75	65	60	65	60	50
Wheat	-	60	0	50	-	-	-	-	-	-	-	-	-	-
Windgrass	-	65	30	60	-	-	-	-	-	-	-	-	-	-

Table C	Compound
62 g ai/ha	19
Postemergence	
Barley	35
Bermudagrass	30
Blackgrass	65
Brome, Downy	50
Canarygrass	60
Chickweed	5
Cocklebur	50
Corn	0
Crabgrass	70
Cupgrass, Woolly	65
Foxtail, Giant	40
Foxtail, Green	45
Goosegrass	0
Johnsongrass	0
Kochia	90
Lambsquarters	90
Morningglory	80
Nutsedge, Yellow	0
Oat, Wild	60
Pigweed	65
Ragweed	70

Ryegrass, Italian	65
Soybean	75
Surinam Grass	45
Velvetleaf	50
Wheat	40
Windgrass	60

Table C	Compounds							
31 g ai/ha	2	3	6	9	11	16	17	19
Postemergence								
Barley	0	0	-	-	-	-	-	25
Bermudagrass	15	0	0	60	0	0	0	5
Blackgrass	60	0	-	-	-	-	-	60
Brome, Downy	20	20	-	-	-	-	-	0
Canarygrass	30	10	-	-	-	-	-	60
Chickweed	60	0	0	15	0	0	0	0
Cocklebur	65	60	0	40	0	75	95	25
Corn	15	0	0	45	0	0	0	0
Crabgrass	40	0	0	60	0	0	0	40
Cupgrass, Woolly	40	0	0	40	0	0	0	25
Foxtail, Giant	0	0	0	60	0	0	0	5
Foxtail, Green	55	20	-	-	-	-	-	35
Goosegrass	0	0	0	0	0	0	0	0
Johnsongrass	0	0	0	55	0	0	0	0
Kochia	85	20	0	95	65	95	100	90
Lambsquarters	100	75	5	90	60	95	95	90
Morningglory	70	45	0	90	0	85	95	55
Nutsedge, Yellow	0	0	0	0	0	0	0	0
Oat, Wild	20	30	-	-	-	-	-	40
Pigweed	65	60	0	55	70	85	45	50
Ragweed	65	55	0	70	45	60	65	40
Ryegrass, Italian	35	35	-	-	-	-	-	65
Soybean	100	60	15	95	60	85	85	55
Surinam Grass	0	0	0	45	0	0	0	25
Velvetleaf	65	25	0	0	50	55	25	40
Wheat	20	0	-	-	-	-	-	30
Windgrass	65	10	-	-	-	-	-	40

Table C	Compounds		
16 g ai/ha	6	11	19
Postemergence			
Barley	-	-	25
Bermudagrass	0	0	0
Blackgrass	-	-	55
Brome, Downy	-	-	0
Canarygrass	-	-	45
Chickweed	-	0	0
Cocklebur	0	0	25
Corn	0	0	0
Crabgrass	0	0	20
Cupgrass, Woolly	0	0	0
Foxtail, Giant	0	0	0
Foxtail, Green	-	-	30
Goosegrass	0	0	0
Johnsongrass	0	0	0
Kochia	0	40	80
Lambsquarters	0	50	70
Morningglory	0	0	-
Nutsedge, Yellow	0	0	0
Oat, Wild	-	-	40
Pigweed	0	60	50
Ragweed	0	15	35
Ryegrass, Italian	-	-	65
Soybean	5	45	45
Surinam Grass	0	0	0
Velvetleaf	0	20	30
Wheat	-	-	10
Windgrass	-	-	40

Table C	Compounds					
500 g ai/ha	1	4	5	8	10	15
Preemergence						
Bermudagrass	90	95	70	100	0	70
Cocklebur	100	100	100	100	100	100
Corn	70	90	50	75	0	60
Crabgrass	95	95	60	0	0	100
Cupgrass, Woolly	95	95	0	100	0	95

Foxtail, Giant	90	85	60	0	0	80
Goosegrass	70	65	40	45	0	0
Johnsongrass	90	95	70	20	0	95
Kochia	100	100	100	100	65	100
Lambsquarters	100	100	100	100	95	100
Morningglory	100	100	100	100	100	100
Nightshade	100	100	100	-	95	100
Nutsedge, Yellow	50	80	0	100	-	20
Pigweed	100	100	100	95	85	100
Ragweed	100	100	100	100	85	100
Soybean	100	100	100	100	-	100
Sunflower	100	100	100	100	0	100
Surinam Grass	90	100	0	100	0	95
Velvetleaf	100	100	90	100	60	100

Table C						Compounds							
250 g ai/ha	1	2	3	4	5	8	9	10	12	13	15	16	17
Preemergence													
Bermudagrass	70	0	0	45	30	100	100	0	20	0	0	0	0
Cocklebur	100	100	70	100	100	100	100	0	90	95	100	100	100
Corn	50	0	0	75	20	10	75	0	-	30	45	75	75
Crabgrass	90	50	0	85	20	0	100	0	0	0	95	95	80
Cupgrass, Woolly	90	45	0	95	0	100	100	0	100	0	85	65	85
Foxtail, Giant	90	30	0	75	10	0	80	0	0	5	65	75	75
Goosegrass	10	60	0	55	0	35	50	0	0	0	0	0	0
Johnsongrass	80	40	0	90	60	0	90	0	5	45	75	80	75
Kochia	100	100	30	100	100	100	100	45	85	85	100	100	85
Lambsquarters	100	100	80	100	100	90	100	65	70	90	100	100	100
Morningglory	100	100	35	100	90	100	100	0	90	90	100	100	100
Nightshade	100	100	20	100	100	-	-	20	80	90	100	100	100
Nutsedge, Yellow	50	0	0	15	0	100	100	-	0	0	0	0	0
Pigweed	100	100	80	100	100	90	100	70	85	90	100	100	100
Ragweed	100	0	45	100	100	100	100	55	85	85	100	100	100
Soybean	100	100	20	100	98	100	100	-	70	90	95	100	100
Sunflower	100	100	0	100	100	100	100	0	85	90	100	100	100
Surinam Grass	90	0	0	85	0	100	100	0	0	10	75	80	0
Velvetleaf	95	90	35	95	90	100	100	0	70	90	100	100	100

Table C	Compounds													
125 g ai/ha	1	2	3	4	5	8	9	10	11	12	13	15	16	17
Preemergence														
Bermudagrass	50	0	0	20	0	100	100	0	0	0	0	0	0	0
Cocklebur	100	80	55	95	90	85	100	0	0	85	90	90	95	95
Corn	0	–	0	0	5	0	60	0	0	60	10	15	20	35
Crabgrass	60	0	0	65	0	0	95	0	60	0	0	95	65	20
Cupgrass, Woolly	60	0	0	80	0	65	95	0	0	10	0	20	15	20
Foxtail, Giant	30	0	0	40	0	0	75	0	20	0	0	0	0	20
Goosegrass	0	0	0	25	0	0	20	0	0	0	0	0	0	0
Johnsongrass	30	0	0	70	20	0	65	0	75	5	5	65	65	55
Kochia	100	95	20	100	95	85	100	0	60	50	80	100	100	25
Lambsquarters	100	100	0	100	95	20	100	50	85	40	90	100	100	100
Morningglory	100	100	20	100	80	100	100	0	0	60	85	100	100	100
Nightshade	100	100	0	100	100	–	–	–	–	60	90	100	95	95
Nutsedge, Yellow	0	0	0	0	0	0	100	0	–	0	0	0	0	0
Pigweed	100	95	65	100	90	85	100	55	90	50	85	100	100	100
Ragweed	100	0	0	100	90	100	100	0	45	20	70	95	95	95
Soybean	100	90	15	100	90	100	100	–	55	–	90	90	100	95
Sunflower	100	100	0	100	90	40	100	0	0	0	60	100	100	100
Surinam Grass	35	0	0	65	0	100	100	0	100	0	0	65	15	0
Velvetleaf	90	75	20	95	85	75	100	0	0	50	80	95	95	100

Table C	Compound
125 g ai/ha	19
Preemergence	
Bermudagrass	0
Cocklebur	80
Corn	0
Crabgrass	0
Cupgrass, Woolly	0
Foxtail, Giant	0
Goosegrass	0
Johnsongrass	55
Kochia	90
Lambsquarters	100
Morningglory	90
Nightshade	100
Nutsedge, Yellow	0

Pigweed	95
Ragweed	80
Soybean	90
Sunflower	90
Surinam Grass	10
Velvetleaf	65

Table C	Compounds													
62 g ai/ha	1	2	3	4	5	8	9	10	11	12	13	15	16	17
Preemergence														
Bermudagrass	0	0	0	0	0	100	100	0	0	0	0	0	0	0
Cocklebur	90	–	30	80	10	–	80	–	0	50	60	65	95	90
Corn	0	0	0	–	5	0	5	0	0	30	5	0	15	20
Crabgrass	10	0	0	40	0	0	95	0	0	0	0	0	0	0
Cupgrass, Woolly	0	0	0	0	0	0	90	0	0	0	0	0	0	0
Foxtail, Giant	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Goosegrass	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Johnsongrass	0	0	0	50	5	0	45	0	0	0	0	20	40	0
Kochia	95	90	0	95	80	50	95	0	0	50	60	95	95	0
Lambsquarters	95	100	0	95	95	0	100	0	40	10	85	95	95	95
Morningglory	90	100	0	100	50	20	100	0	0	60	65	95	95	95
Nightshade	100	20	0	100	100	–	–	–	–	50	0	95	90	80
Nutsedge, Yellow	0	0	0	0	0	0	100	0	0	0	0	0	0	0
Pigweed	90	95	50	95	60	65	95	20	65	50	60	90	95	100
Ragweed	95	0	0	100	85	100	100	0	20	10	60	90	90	80
Soybean	85	75	0	95	85	100	100	0	–	50	60	75	85	90
Sunflower	80	100	0	100	60	20	100	0	0	0	50	65	85	95
Surinam Grass	0	0	0	0	0	0	100	–	100	–	0	15	0	0
Velvetleaf	80	50	0	75	85	65	95	0	0	5	60	80	90	80

Table C	Compound
62 g ai/ha	19
Preemergence	
Bermudagrass	0
Cocklebur	65
Corn	0
Crabgrass	0
Cupgrass, Woolly	0
Foxtail, Giant	0

Goosegrass	0
Johnsongrass	35
Kochia	85
Lambsquarters	100
Morningglory	90
Nightshade	100
Nutsedge, Yellow	0
Pigweed	70
Ragweed	70
Soybean	85
Sunflower	70
Surinam Grass	0
Velvetleaf	40

Table C				Compounds					
31 g ai/ha	2	3	9	11	12	13	16	17	19
Preemergence									
Bermudagrass	0	0	100	0	0	0	0	0	0
Cocklebur	60	0	75	0	50	40	45	75	30
Corn	0	0	0	0	0	0	0	0	0
Crabgrass	0	0	20	0	0	0	0	0	0
Cupgrass, Woolly	0	0	0	0	0	0	0	0	0
Foxtail, Giant	0	0	0	0	0	0	0	0	0
Goosegrass	0	0	0	0	0	0	0	0	0
Johnsongrass	0	0	15	0	0	0	0	0	0
Kochia	75	0	95	0	0	45	90	0	-
Lambsquarters	90	0	95	0	0	50	95	95	100
Morningglory	100	0	100	0	30	60	65	70	10
Nightshade	0	0	-	-	-	0	55	-	40
Nutsedge, Yellow	0	0	20	0	0	0	0	0	0
Pigweed	90	20	95	0	10	50	85	95	45
Ragweed	0	0	100	0	-	45	45	70	55
Soybean	15	0	100	-	-	0	75	70	25
Sunflower	20	0	100	0	0	5	20	60	25
Surinam Grass	0	0	95	0	0	0	0	0	-
Velvetleaf	20	0	70	0	0	60	25	20	35

Table C	Compounds	
16 g ai/ha	11	19
Preemergence		
Bermudagrass	0	0
Cocklebur	0	15
Corn	0	0
Crabgrass	0	0
Cupgrass, Woolly	0	0
Foxtail, Giant	0	0
Goosegrass	0	0
Johnsongrass	0	0
Kochia	0	35
Lambsquarters	0	75
Morningglory	0	10
Nightshade	-	0
Nutsedge, Yellow	0	0
Pigweed	0	35
Ragweed	0	55
Soybean	-	0
Sunflower	0	10
Surinam Grass	0	0
Velvetleaf	0	25

TEST D

Seeds of plant species selected from bermudagrass (*Cynodon dactylon*), Kentucky (KY) bluegrass (*Poa pratensis*), bentgrass (*Agrostis palustris*), fine fescue (*Festuca rubra*), large crabgrass (*Digitaria sanguinalis*), goosegrass (*Eleusine indica*), dallisgrass (*Paspalum dilatatum*), annual bluegrass (*Poa annua*), common chickweed (*Stellaria media*), dandelion (*Taraxacum officinale*), white clover (*Trifolium repens*), and yellow nutsedge (*Cyperus esculentus*) were planted and treated preemergence with test chemicals formulated in a non-phytotoxic solvent mixture which included a surfactant.

At the same time, plants selected from these weed species were treated with postemergence applications of some of the test chemicals formulated in the same manner. Plants ranged in height from 2 to 18 cm (1- to 4-leaf stage) for postemergence treatments. Treated plants and controls were maintained in a greenhouse for 12 to 14 days, after which time all species were compared to controls and visually evaluated. Plant response ratings, summarized in Table D, are based on a scale of 0 to 100 where 0 is no effect and 100 is complete control. A dash (–) response means no test result.

Table D	Compound
500 g ai/ha	1
Postemergence	
Bentgrass	70
Bermudagrass	70
Bluegrass	95
Bluegrass, KY	30
Chickweed	100
Clover, White	100
Crabgrass	90
Dallisgrass	60
Dandelion	95
Fescue, Hard	0
Goosegrass	50
Nutsedge, Yellow	15

Table D	Compound
250 g ai/ha	1
Postemergence	
Bentgrass	50
Bermudagrass	50
Bluegrass	70
Bluegrass, KY	0
Chickweed	85
Clover, White	100
Crabgrass	75
Dallisgrass	75
Dandelion	85
Fescue, Hard	0
Goosegrass	40
Nutsedge, Yellow	15

Table D	Compound
125 g ai/ha	1
Postemergence	
Bentgrass	50
Bermudagrass	40
Bluegrass	45
Bluegrass, KY	0
Chickweed	85
Clover, White	100
Crabgrass	70
Dallisgrass	15
Dandelion	75
Fescue, Hard	0
Goosegrass	35
Nutsedge, Yellow	10

Table D	Compound
62 g ai/ha	1
Postemergence	
Bentgrass	30
Bermudagrass	20
Bluegrass, KY	0
Chickweed	80
Clover, White	90
Crabgrass	45
Dallisgrass	0
Dandelion	75
Fescue, Hard	0
Goosegrass	10
Nutsedge, Yellow	10

Table D	Compound
31 g ai/ha	1
Postemergence	
Bentgrass	0
Bermudagrass	0
Bluegrass	35
Bluegrass, KY	20
Chickweed	0
Clover, White	70
Crabgrass	0
Dallisgrass	0
Dandelion	50
Fescue, Hard	0
Goosegrass	5
Nutsedge, Yellow	0

Table D	Compound
250 g ai/ha	1
Preemergence	
Bentgrass	90
Bermudagrass	80
Bluegrass	70
Bluegrass, KY	40
Chickweed	100
Clover, White	100
Crabgrass	95
Dallisgrass	70
Dandelion	100
Fescue, Hard	60
Goosegrass	65
Nutsedge, Yellow	25

Table D	Compound
62 g ai/ha	1
Preemergence	
Bentgrass	60
Bermudagrass	40
Bluegrass	65
Bluegrass, KY	30

Table D	Compound
500 g ai/ha	1
Preemergence	
Bentgrass	100
Bermudagrass	90
Bluegrass	70
Bluegrass, KY	80
Chickweed	100
Clover, White	100
Crabgrass	100
Dallisgrass	95
Dandelion	100
Fescue, Hard	90
Goosegrass	85
Nutsedge, Yellow	70

Table D	Compound
125 g ai/ha	1
Preemergence	
Bentgrass	60
Bermudagrass	50
Bluegrass	45
Bluegrass, KY	30
Chickweed	100
Clover, White	100
Crabgrass	85
Dallisgrass	45
Dandelion	100
Fescue, Hard	60
Goosegrass	30
Nutsedge, Yellow	30

Table D	Compound
31 g ai/ha	1
Preemergence	
Bentgrass	50
Bermudagrass	10
Bluegrass	20
Bluegrass, KY	0

Chickweed	100	Chickweed	80
Clover, White	100	Clover, White	80
Crabgrass	40	Crabgrass	15
Dallisgrass	35	Dallisgrass	10
Dandelion	95	Dandelion	35
Fescue, Hard	60	Fescue, Hard	50
Goosegrass	40	Goosegrass	30
Nutsedge, Yellow	15	Nutsedge, Yellow	0

TEST E

Seeds of plant species selected from bermudagrass (*Cynodon dactylon*), Surinam grass (*Brachiaria decumbens*), large crabgrass (*Digitaria sanguinalis*), green foxtail (*Setaria viridis*), goosegrass (*Eleusine indica*), johnsongrass (*Sorghum halepense*), kochia (*Kochia scoparia*), pitted morningglory (*Ipomoea lacunosa*), purple nutsedge (*Cyperus rotundus*), common ragweed (*Ambrosia elatior*), mustard (*Brassica nigra*), guineagrass (*Panicum maximum*), dallisgrass (*Paspalum dilatatum*), barnyardgrass (*Echinochloa crus-galli*), southern sandbur (*Cenchrus echinatus*), common sowthistle (*Sonchus oleraceous*), prickly sida (*Sida spinosa*), Italian ryegrass (*Lolium multiflorum*), common purslane (*Portulaca oleracea*), broadleaf Signalgrass (*Brachiaria platyphylla*), common groundsel (*Senecio vulgaris*), common chickweed (*Stellaria media*), tropical spiderwort (*Commelina benghalensis*), annual bluegrass (Poa annua), downy bromegrass (*Bromus tectorum*), itchgrass (*Rottboellia cochinchinensis*), quackgrass (*Elytrigia repens*), Canada horseweed (*Conyza canadensis*), field bindweed (*Convolvulus arvensis*), spanishneedles (*Bidens bipinnata*), common mallow (*Malva sylvestris*), and Russian thistle (*Salsola kali*) were planted and treated preemergence with test chemicals formulated in a non-phytotoxic solvent mixture which included a surfactant.

At the same time, plants selected from these weed species were treated with postemergence applications of some of the test chemicals formulated in the same manner. Plants ranged in height from 2 to 18 cm (1- to 4-leaf stage) for postemergence treatments. Treated plants and controls were maintained in a greenhouse for 12 to 14 days, after which time all species were compared to controls and visually evaluated. Plant response ratings, summarized in Table E, are based on a scale of 0 to 100 where 0 is no effect and 100 is complete control. A dash (–) response means no test result.

Table E	Compound	Table E	Compound
500 g ai/ha	1	375 g ai/ha	1
Postemergence		Postemergence	
Barnyardgrass	75	Barnyardgrass	70
Bermudagrass	50	Bermudagrass	40

Bindweed, Field	95
Black Mustard	75
Bluegrass	50
Brome, Downy	80
Crabgrass	70
Dallisgrass	30
Foxtail, Green	60
Goosegrass	60
Groundsel	100
Guineagrass	95
Horseweed	100
Itchgrass	70
Johnsongrass	95
Mallow	95
Morningglory	100
Nutsedge, Purple	30
Prickly Sida	95
Purslane	100
Quackgrass	70
Ragweed	100
Ryegrass, Italian	40
Sandbur	95
Signalgrass	85
Sowthistle	100
Spanishneedles	95
Spiderwort	95
Surinam Grass	90

Table E	Compound
250 g ai/ha	1
Postemergence	
Barnyardgrass	70
Bermudagrass	40
Bindweed, Field	95
Black Mustard	75
Bluegrass	40

Bindweed, Field	95
Black Mustard	75
Bluegrass	50
Brome, Downy	70
Chickweed	100
Crabgrass	70
Dallisgrass	30
Foxtail, Green	50
Goosegrass	60
Groundsel	100
Horseweed	100
Itchgrass	60
Johnsongrass	95
Kochia	95
Mallow	95
Morningglory	100
Nutsedge, Purple	30
Prickly Sida	95
Purslane	100
Quackgrass	70
Ragweed	100
Russian Thistle	100
Ryegrass, Italian	40
Sandbur	95
Signalgrass	75
Sowthistle	95
Spanishneedles	95
Spiderwort	95
Surinam Grass	90

Table E	Compound
125 g ai/ha	1
Postemergence	
Barnyardgrass	60
Bermudagrass	25
Bindweed, Field	95
Black Mustard	75
Bluegrass	30

Brome, Downy	60
Chickweed	95
Crabgrass	70
Dallisgrass	30
Foxtail, Green	30
Goosegrass	60
Groundsel	95
Guineagrass	95
Horseweed	100
Itchgrass	60
Johnsongrass	95
Mallow	70
Morningglory	100
Nutsedge, Purple	20
Prickly Sida	90
Purslane	100
Quackgrass	60
Ragweed	95
Russian Thistle	100
Ryegrass, Italian	40
Sandbur	95
Signalgrass	75
Sowthistle	95
Spanishneedles	95
Spiderwort	95
Surinam Grass	85

Table E	Compound
62 g ai/ha	1
Postemergence	
Barnyardgrass	60
Bermudagrass	25
Bindweed, Field	90
Black Mustard	60
Bluegrass	20
Brome, Downy	30
Crabgrass	50
Dallisgrass	10

Brome, Downy	30
Chickweed	95
Crabgrass	60
Dallisgrass	20
Foxtail, Green	20
Goosegrass	60
Groundsel	95
Guineagrass	70
Horseweed	70
Itchgrass	40
Johnsongrass	70
Mallow	60
Morningglory	100
Nutsedge, Purple	10
Prickly Sida	70
Purslane	100
Quackgrass	30
Ragweed	95
Russian Thistle	100
Ryegrass, Italian	10
Sandbur	60
Signalgrass	60
Sowthistle	95
Spanishneedles	95
Spiderwort	95
Surinam Grass	60

Table E	Compounds	
500 g ai/ha	1	4
Preemergence		
Barnyardgrass	70	100
Bermudagrass	70	100
Bindweed, Field	100	100
Black Mustard	100	100
Bluegrass	85	100
Brome, Downy	95	100
Chickweed	100	100
Crabgrass	90	100

Foxtail, Green	10
Goosegrass	20
Groundsel	60
Guineagrass	60
Itchgrass	20
Johnsongrass	70
Mallow	50
Morningglory	100
Prickly Sida	70
Purslane	80
Quackgrass	10
Ragweed	75
Russian Thistle	100
Ryegrass, Italian	0
Sandbur	30
Signalgrass	20
Sowthistle	95
Spanishneedles	80
Spiderwort	95
Surinam Grass	30

Dallisgrass	95	100
Foxtail, Green	90	100
Goosegrass	50	90
Groundsel	100	100
Guineagrass	100	100
Horseweed	100	100
Itchgrass	90	95
Johnsongrass	75	95
Kochia	100	-
Mallow	95	100
Morningglory	100	100
Nutsedge, Purple	100	100
Prickly Sida	100	100
Purslane	100	100
Quackgrass	95	100
Ragweed	100	100
Russian Thistle	100	100
Ryegrass, Italian	95	100
Sandbur	85	100
Signalgrass	95	95
Sowthistle	100	100
Spanishneedles	100	100
Spiderwort	100	100
Surinam Grass	100	95

Table E	Compound
375 g ai/ha	1
Preemergence	
Barnyardgrass	70
Bermudagrass	70
Bindweed, Field	100
Black Mustard	100
Brome, Downy	95
Chickweed	100
Crabgrass	90
Dallisgrass	95
Foxtail, Green	90
Goosegrass	50

Table E	Compounds	
250 g ai/ha	1	4
Preemergence		
Barnyardgrass	50	80
Bermudagrass	30	95
Bindweed, Field	100	100
Black Mustard	85	100
Bluegrass	85	80
Brome, Downy	95	100
Chickweed	95	100
Crabgrass	90	100
Dallisgrass	50	95
Foxtail, Green	50	100

Groundsel	100
Guineagrass	100
Horseweed	100
Itchgrass	85
Johnsongrass	75
Kochia	100
Mallow	95
Morningglory	100
Nutsedge, Purple	100
Prickly Sida	100
Purslane	100
Quackgrass	95
Ragweed	100
Russian Thistle	100
Ryegrass, Italian	95
Sandbur	85
Signalgrass	75
Sowthistle	100
Spanishneedles	100
Spiderwort	100
Surinam Grass	95

Goosegrass	50	70
Groundsel	100	100
Guineagrass	85	100
Horseweed	100	100
Itchgrass	80	80
Johnsongrass	60	85
Kochia	100	-
Mallow	95	100
Morningglory	100	100
Nutsedge, Purple	100	100
Prickly Sida	100	100
Purslane	95	100
Quackgrass	90	100
Ragweed	100	100
Russian Thistle	100	100
Ryegrass, Italian	30	100
Sandbur	70	90
Signalgrass	75	95
Sowthistle	100	100
Spanishneedles	100	100
Spiderwort	100	100
Surinam Grass	95	80

Table E	Compounds	
125 g ai/ha	1	4
Preemergence		
Barnyardgrass	20	70
Bermudagrass	20	90
Bindweed, Field	100	100
Black Mustard	80	95
Bluegrass	30	60
Brome, Downy	20	70
Chickweed	95	100
Crabgrass	30	75
Dallisgrass	10	50
Foxtail, Green	10	70
Goosegrass	-	60
Groundsel	100	95

Table E	Compounds	
62 g ai/ha	1	4
Preemergence		
Barnyardgrass	0	50
Bermudagrass	10	20
Bindweed, Field	95	100
Black Mustard	30	95
Bluegrass	10	10
Brome, Downy	0	30
Chickweed	70	100
Crabgrass	20	60
Dallisgrass	0	0
Foxtail, Green	10	20
Goosegrass	0	10
Groundsel	60	95

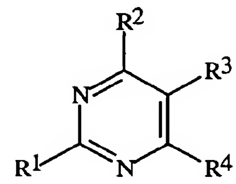
Guineagrass	70	95
Horseweed	95	100
Itchgrass	30	70
Johnsongrass	40	75
Kochia	100	-
Mallow	80	100
Morningglory	100	100
Nutsedge, Purple	100	100
Prickly Sida	100	100
Purslane	60	100
Quackgrass	60	90
Ragweed	95	100
Russian Thistle	100	100
Ryegrass, Italian	10	60
Sandbur	30	80
Signalgrass	70	70
Sowthistle	100	100
Spanishneedles	100	100
Spiderwort	100	100
Surinam Grass	95	60

Guineagrass	70	95
Horseweed	95	100
Itchgrass	10	70
Johnsongrass	20	60
Kochia	100	-
Mallow	50	100
Morningglory	95	100
Nutsedge, Purple	10	40
Prickly Sida	70	85
Purslane	10	60
Quackgrass	10	60
Ragweed	50	80
Russian Thistle	100	-
Ryegrass, Italian	0	30
Sandbur	0	30
Signalgrass	10	50
Sowthistle	95	100
Spanishneedles	100	100
Spiderwort	70	100
Surinam Grass	95	30

CLAIMS

What is claimed is:

1. A compound selected from Formula **I**, an *N*-oxide or an agriculturally suitable salt thereof,



I

wherein

R^1 is cyclopropyl optionally substituted with 1–5 R^5, isopropyl optionally substituted with 1–5 R^6, or phenyl optionally substituted with 1–2 R^7; or R^1 is halogen, OR^8, SR^9 or $N(R^{10})R^{11}$;

R^2 is CO_2R^{12}, CH_2OR^{13}, CHO, $C(=NOR^{14})H$, $C(R^{15})(R^{16})CO_2R^{17}$ or $C(=O)N(R^{18})R^{19}$;

R^3 is halogen, cyano, nitro, OR^{20}, SR^{21} or $N(R^{22})R^{23}$;

R^4 is $-N(R^{24})R^{25}$ or $-NO_2$;

each R^5 and R^6 is independently halogen, C_1–C_2 alkyl or C_1–C_2 haloalkyl;

each R^7 is independently halogen, C_1–C_4 alkyl, C_1–C_3 haloalkyl, C_1–C_3 alkoxy, C_1–C_3 haloalkoxy, C_1–C_3 alkylthio or C_1–C_3 haloalkylthio;

R^8 is H, C_1–C_4 alkyl, C_1–C_3 haloalkyl or phenyl optionally substituted with 1–2 R^{26};

R^9 is H, C_1–C_4 alkyl or C_1–C_3 haloalkyl;

R^{10} is H or C_1–C_4 alkyl;

R^{11} is C_1–C_4 alkyl;

or R^{10} and R^{11} are taken together as $-(CH_2)_m-$ or $-(CH_2)_2O(CH_2)_2-$;

R^{12} is H; or a radical selected from C_1–C_{14} alkyl, C_3–C_{12} cycloalkyl, C_4–C_{12} alkylcycloalkyl, C_4–C_{12} cycloalkylalkyl, C_2–C_{14} alkenyl and C_2–C_{14} alkynyl, each radical optionally substituted with 1–3 R^{27};

R^{13} is H, C_1–C_{10} alkyl optionally substituted with 1–3 R^{28} or benzyl;

R^{14} is H, C_1–C_4 alkyl or C_1–C_4 haloalkyl;

R^{15} and R^{16} are independently H, halogen, C_1–C_4 alkyl, C_1–C_4 haloalkyl, hydroxy or C_1–C_4 alkoxy;

R^{17} is C_1–C_{10} alkyl optionally substituted with 1–3 R^{29} or benzyl;

R^{18} and R^{19} are independently H or C_1–C_4 alkyl;

R^{20} is H, C_1–C_4 alkyl or C_1–C_3 haloalkyl;

R^{21} is H, C_1–C_4 alkyl or C_1–C_3 haloalkyl;

R^{22} and R^{23} are independently H or C_1–C_4 alkyl;

R^{24} is H, C_1–C_4 alkyl optionally substituted with 1–2 R^{30}, C_2–C_4 alkenyl optionally substituted with 1–2 R^{31}, or C_2–C_4 alkynyl optionally substituted with 1–2 R^{32}; or R^{24} is $C(=O)R^{33}$, nitro, OR^{34}, $S(O)_2R^{35}$ or $N(R^{36})R^{37}$;

R^{25} is H, C_1–C_4 alkyl optionally substituted with 1–2 R^{30} or $C(=O)R^{33}$; or

R^{24} and R^{25} are taken together as a radical selected from $-(CH_2)_4-$, $-(CH_2)_5-$, $-CH_2CH=CHCH_2-$ and $-(CH_2)_2O(CH_2)_2-$, each radical optionally substituted with 1–2 R^{38}; or

R^{24} and R^{25} are taken together as $=C(R^{39})N(R^{40})R^{41}$ or $=C(R^{42})OR^{43}$;

each R^{26} is independently halogen, C_1–C_4 alkyl, C_1–C_3 haloalkyl, C_1–C_3 alkoxy, C_1–C_3 haloalkoxy, C_1–C_3 alkylthio or C_1–C_3 haloalkylthio;

each R^{27} is independently halogen, hydroxycarbonyl, C_2–C_4 alkoxycarbonyl, hydroxy, C_1–C_4 alkoxy, C_1–C_4 haloalkoxy, C_1–C_4 alkylthio, C_1–C_4 haloalkylthio, amino, C_1–C_4 alkylamino, C_1–C_4 dialkylamino, $-CH[O(CH_2)_n]$ or phenyl optionally substituted with 1–3 R^{44}; or

two R^{27} are taken together with the carbon atom to which they are attached to form a carbonyl moiety;

each R^{28} and R^{29} is independently halogen, C_1–C_4 alkoxy, C_1–C_4 haloalkoxy, C_1–C_4 alkylthio, C_1–C_4 haloalkylthio, amino, C_1–C_4 alkylamino or C_1–C_4 dialkylamino;

each R^{30}, R^{31} and R^{32} is independently halogen, hydroxy, C_1–C_4 alkoxy, C_1–C_4 haloalkoxy, C_1–C_4 alkylthio, C_1–C_4 haloalkylthio, amino, C_1–C_4 alkylamino, C_1–C_4 dialkylamino or C_2–C_4 alkoxycarbonyl;

each R^{33} is independently H, C_1–C_4 alkyl, C_1–C_3 haloalkyl, C_1–C_4 alkoxy, phenoxy or benzyloxy;

R^{34} is H, C_1–C_4 alkyl or C_1–C_3 haloalkyl;

R^{35} is C_1–C_4 alkyl or C_1–C_3 haloalkyl;

R^{36} and R^{37} are independently H or C_1–C_4 alkyl;

each R^{38} is independently halogen, C_1–C_3 alkyl, C_1–C_3 alkoxy, C_1–C_3 haloalkoxy, C_1–C_3 alkylthio, C_1–C_3 haloalkylthio, amino, C_1–C_3 alkylamino, C_1–C_4 dialkylamino or C_2–C_4 alkoxycarbonyl;

R^{39} is H or C_1–C_4 alkyl;

R^{40} and R^{41} are independently H or C_1–C_4 alkyl; or

R^{40} and R^{41} are taken together as $-(CH_2)_4-$, $-(CH_2)_5-$, $-CH_2CH=CHCH_2-$ or $-(CH_2)_2O(CH_2)_2-$;

R^{42} is H or C_1–C_4 alkyl;

R^{43} is H or C_1–C_4 alkyl;

each R^{44} is independently halogen, C_1–C_4 alkyl, C_1–C_3 haloalkyl, hydroxy, C_1–C_4 alkoxy, C_1–C_3 haloalkoxy, C_1–C_4 alkylthio, C_1–C_3 haloalkylthio, amino, C_1–C_3 alkylamino, C_1–C_4 dialkylamino or nitro;

m is an integer from 2 to 5; and

n is an integer from 1 to 4;

provided that:

(a) when R^2 is CH_2OR^{13}, then R^1 is other than SCH_3, and R^{24} and R^{25} are H;

(b) when R^1 and R^3 are halogen, then R^4 is NH_2; and

(c) when R^1 is SCH_3, then R^3 is Cl.

2. The compound of Claim 1 wherein R^1 is cyclopropyl; and R^4 is $-N(R^{24})R^{25}$.

3. The compound of Claim 2 wherein R^2 is CO_2R^{12}; and R^{24} and R^{25} are H.

4. The compound of Claim 2 wherein R^3 is halogen.

5. The compound of Claim 4 wherein R^2 is CO_2R^{12}, CH_2OR^{13}, CHO or $CH_2CO_2R^{17}$.

6. The compound of Claim 5 wherein R^{24} is H or C_1–C_4 alkyl optionally substituted with R^{30}; R^{25} is H or C_1–C_2 alkyl; or R^{24} and R^{25} are taken together as $=C(R^{39})N(R^{40})R^{41}$.

7. The compound of Claim 6 wherein R^2 is CO_2R^{12}; and R^{12} is H or C_1–C_4 alkyl.

8. The compound of Claim 7 wherein R^{24} and R^{25} are H.

9. The compound of Claim 1 selected from the group consisting of:

methyl 6-amino-5-bromo-2-cyclopropyl-4-pyrimidinecarboxylate,

ethyl 6-amino-5-bromo-2-cyclopropyl-4-pyrimidinecarboxylate,

methyl 6-amino-5-chloro-2-cyclopropyl-4-pyrimidinecarboxylate, and

ethyl 6-amino-5-chloro-2-cyclopropyl-4-pyrimidinecarboxylate.

10. A herbicidal composition comprising a herbicidally effective amount of a compound of Claim 1 and at least one of a surfactant, a solid diluent or a liquid diluent.

11. A method for controlling the growth of undesired vegetation comprising contacting the vegetation or its environment with a herbicidally effective amount of a compound of Claim 1.

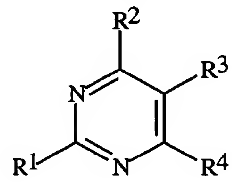
12. A herbicidal composition comprising a herbicidally effective amount of a compound of Claim 1, an effective amount of at least one additional active ingredient selected from the group consisting of an other herbicide and a herbicide safener, and at least one of a surfactant, a solid diluent or a liquid diluent.

TITLE

HERBICIDAL PYRIMIDINES

ABSTRACT OF THE DISCLOSURE

Compounds of Formula **I**, and their *N*-oxides and agriculturally suitable salts, are disclosed which are useful for controlling undesired vegetation



I

wherein

R^1 is cyclopropyl optionally substituted with 1–5 R^5, isopropyl optionally substituted with 1–5 R^6, or phenyl optionally substituted with 1–2 R^7; or R^1 is halogen, OR^8, SR^9 or $N(R^{10})R^{11}$;

R^2 is CO_2R^{12}, CH_2OR^{13}, CHO, $C(=NOR^{14})H$, $C(R^{15})(R^{16})CO_2R^{17}$ or $C(=O)N(R^{18})R^{19}$;

R^3 is halogen, cyano, nitro, OR^{20}, SR^{21} or $N(R^{22})R^{23}$;

R^4 is $-N(R^{24})R^{25}$ or $-NO_2$;

and R^5, R^6, R^7, R^8, R^9, R^{10}, R^{11}, R^{12}, R^{13}, R^{14}, R^{15}, R^{16}, R^{17}, R^{18}, R^{19}, R^{20}, R^{21}, R^{22}, R^{23}, R^{24} and R^{25} are as defined in the disclosure.

Also disclosed are compositions comprising the compounds of Formula **I** and a method for controlling undesired vegetation which involves contacting the vegetation or its environment with an effective amount of a compound of Formula **I**. Also disclosed are compositions comprising a compound of Formula **I** and at least one additional active ingredient selected from the group consisting of an other herbicide and a herbicide safener.